

J. B. Tyrrell, Photo.

NORTH SHORE OF LAKE WINNIPEG, CLIFFS OF PEAT ABOVE BEDS OF CLAY AND SAND.

GEOLOGICAL SURVEY OF CANADA

G. M. DAWSON, C.M.G., LL.D., F.R.S., DIRECTOR

REPORT

ON THE

EAST SHORE OF LAKE WINNIPEG

AND ADJACENT PARTS OF

MANITOBA AND KEEWATIN

From notes and surveys

BY

J. BURR TYRRELL, M.A., F.G.S., &c.

COMPILED BY

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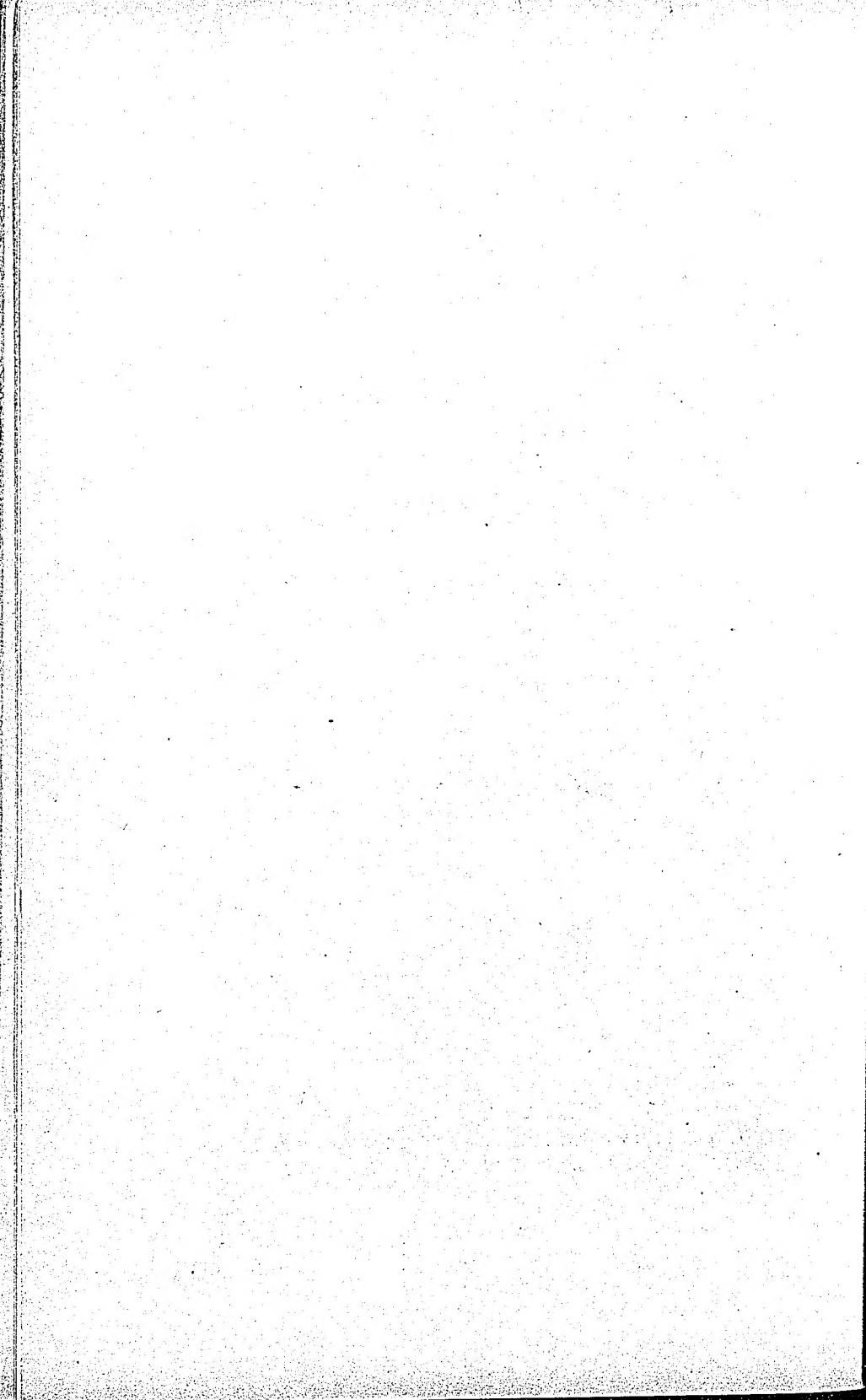


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TO G. M. DAWSON, C.M.G., LL.D., F.R.S.,
Director of the Geological Survey of Canada.

SIR,—I beg to present herewith a report on the country bordering the east shore of Lake Winnipeg. This region was examined by Mr. J. B. Tyrrell in 1890 and 1891. Subsequently, in 1895, while exploring the country to the north, a survey of Gunisao River was added, thus completing the examination of the streams flowing through the country comprised within the limits of the accompanying map. Previous to Mr. Tyrrell's resignation from the staff of the Survey, he had written a portion of a report dealing with description of the Archæan rocks exposed on the lake and entering streams, as far south as Dog Head. In this I have interpolated notes on the surface deposits and general descriptions extracted from his note books, and in like manner have added a general description of the shores and entering streams as far as the Red River. The notes of Mr. A. S. Cochrane's survey of Poplar and Big Black rivers are also utilized. Thin sections of a large number of the rock specimens from this district had been examined by Mr. W. F. Ferrier, and where detailed descriptions are added, they are mainly from his notes.

The general arrangement of the report is in the form of a description from the north end of the lake southward, to the mouth of the Red River.

I have the honour to be, Sir,
Your obedient servant,

D. B. DOWLING.

NOTE—*The bearings throughout this report refer to the true meridian.*

REPORT
ON THE
EAST SHORE OF LAKE WINNIPEG
AND ADJACENT PARTS OF
MANITOBA AND KEEWATIN

GENERAL DESCRIPTION OF THE COUNTRY EAST OF LAKE WINNIPEG.

The east shore of Lake Winnipeg is in marked contrast to the west. General description. Its general outline is remarkably straight, showing the very even nature of the surface upon which the later stratified rocks of the central part of the continent were deposited. The rocks are all Archæan and the great preponderance of gneisses and granites of the Laurentian is the chief feature. Small areas of Huronian greenstones and schists occur in two localities, one on Lac du Bonnet and the other at the mouth of Wannipegow River.

The general character of the shore-line differs but little from that of other lakes in the Archæan areas in which the basin occupied is of a shallow nature. Character of east shore. Owing to the slight slope toward the lake from the east, the uneven rocky surface, as submerged, forms all along, a series of outlying islands, and off the points long lines of shoals. The strike of the rocks in some cases influences the direction of the shoals, but the major portion of the shore is apparently independent of it. One instance of the strike determining the direction of the shore is along that portion opposite Bull Head.

In the northern part of the lake the prominent points run out Shoals off points. in a north-westerly direction, and the continuation of the submerged surface is shown in long lines of shoals of which the trend is in the same direction. This character proves a serious obstacle to the navigation of the eastern part of the lake by large vessels, as harbours, though numerous, are difficult to approach unless extensively buoyed or

marked. The mouths of all the large streams on which lumbering operations might be conducted are similarly obstructed. The bay into which Berens River enters is very difficult of approach, and the same is true also of the mouth of Poplar River. The outlet of the lake through Playgreen Lake is through a maze of shoals, and the steamer that makes an annual trip to Norway House seldom passes through without striking some of these, even when in charge of an experienced pilot. The following general description of the physical features of this shore and entering streams is extracted from the Summary Reports of J. B. Tyrrell to the Director for the years 1890, 1891 and 1895 :—

North shore. 'Limestone Bay, is cut off from the rest of the lake by a narrow spit of sand, twelve miles in length, projecting towards the south-west. From the base of this spit an even unbroken sand-beach stretches eastward to near Mossy Point, while behind the beach is an almost vertical cliff, rising in some places to a height of forty feet, composed at the bottom of a stiff blue alluvial clay, and at the top of a mossy peat. Nelson River at the discharge of this lake flows over a bed of Laurentian gneiss which it has not worn sufficiently even to obliterate the well defined glacial striae that may be seen on almost any of the rocks along its shore. It is, however, enlarging and deepening its channel by cutting away the alluvial point lying to the west of it, on which the storehouse of the Hudson's Bay Company is at present situated. This point, which stretches as a long narrow arm between Winnipeg and Playgreen lakes is also being rapidly worn away by the waves of both these lakes, and the time is not very remote when the site of the present narrow arm of alluvial clay and peat will be at the bottom of the united lakes.'

Great Playgreen Lake. 'The north-eastern shore of Great Playgreen Lake is entirely underlain by Archæan granites and gneisses, while the south-western shore is composed of the stratified post-glacial clays, which form the long, narrow point separating that lake from Lake Winnipeg. Nelson River issues from Great Playgreen Lake in several channels. On Little Playgreen Lake the rock is generally a very uniform gray granite, although at one place, near the south end, it is associated with a dark rather coarse-grained massive diorite, and near the north end of the lake, it is cut by veins of red pegmatite containing crystalline aggregates of molybdenite.'

Gunisao River. 'Gunisao River near its mouth winds without perceptible current through an extensive marsh, with a width of from fifty to one hundred yards. The water is of a dark-brown colour and slightly murky. Up to the Forks, a distance of eighteen miles the banks are low and

but scantily wooded, with a few rounded bosses of gray gneiss rising here and there. The stream is interrupted by four rapids, past two of which are portages, respectively 100 and 185 yards in length.

'Above the Forks the south branch is the larger. On this many rapids obstruct the stream, up some of which the canoe was hauled with a line, while past twenty-two of the most serious it was necessary to carry the canoe. For about fifty miles above the Forks, the river flows through a clay-covered country sloping gently towards the north-west, and has cut a channel or valley varying in depth from six to twenty-five feet. In places it has cut down to the underlying granite or gneiss, which then usually forms a barrier over which is a fall or rapid. Between these rocky rapids is slack water, and rock exposures are infrequent, and where seen are constantly of gray or reddish-gray granite. The banks are wooded with beautiful, tall, white spruce, apparently forming a magnificent coniferous forest, but how far back from the river this forest extends, was not determined. There is certainly here a large quantity of valuable timber, much more than was seen anywhere else in the country immediately east of Lake Winnipeg, for most of the surface farther south has been swept by extensive forest fires within the last decade. Good timber.

'In the upper half of the river, the banks are low and much less clearly defined. Deep bays filled with wild rice, extend between the rocky knolls back to swamps, wooded with tamarck and small black spruce, generally killed by fire.

'Gunisao Lake is a lake of clear cold water, with irregular contour, about thirty-two miles in length, and with steep, almost bare rocky shores of gray granite. The rowan bush was seen growing on some of its many rocky islands. Gunisao Lake.

'The channel of the north branch or McLaughlin River is almost as large as that of the south branch and carries about two-thirds as much water, but the banks, in the lower part at least, are rather more rocky and barren, and almost all the timber has been destroyed by fire. There are but ten portages on this river, but for long distances the current is very swift, and the river has not yet cut for itself a channel of any considerable depth. Throughout its whole course from the long narrow lake to its mouth, the river flows through a level, clay-covered country, the rock merely rising here and there in knolls and ridges above the general level. McLaughlin River.

'Along the shore from the Nelson River to Berens River, the rock is found to be Laurentian gneiss, without any constant dip or strike. Nelson River to Berens River.

Belanger
River.

It was also found to be strongly glaciated, and in several places two sets of striæ could be clearly recognized. It is generally covered by a soft, blue, imperfectly stratified alluvial clay. Belanger River for twelve miles up, to the first portage, is from sixty to one hundred yards wide, with clay banks six to fifteen feet high, wooded with white poplar and small black spruce. A low outcrop of gray granite may be seen here and there. The water is dark coloured and muddy. Above this portage the river has a width of from thirty to fifty yards.'

'The river was found to rise not far from Gunisao Lake, and there is said to be a practicable canoe-route in high water from it to the lake. The current is often swift, and the channel crooked and overhung with willows. The banks are everywhere composed of stratified clay or silt, and much of the country has been well wooded, but unfortunately nearly all the timber has been destroyed by fire in comparatively recent years. Some small trees of Manitoba maple (*Negundo aceroides*), were growing by one of the lower rapids. The rock wherever seen, was a uniform gray granite.'

Big Black
River.

On the Big Black River, Mr. Cochrane reports the soil as excellent, and would probably produce larger timber than that now growing, but for recent forest fires. The water in the river is of a dark

Poplar River
and Berens
River

colour and muddy. On Poplar River the rock exposures are not so frequent, and there seems to be also the same class of good soil. Berens River as reported by Mr. A. P. Low, flows through a country underlain by granites and gneisses. The general character of the stream is very much like that of a canal where the locks are represented by

Pot-hole Port-
age, Berens
River

narrow chutes. Pot-hole Portage on this river is thus described by Mr. Tyrrell :—'Just below a little rapid with a drop of thirty inches, at the west end of Long Lake, is a granite hill, on the south-east side of which, facing up the river, is a group of seven large pot-holes, besides several smaller ones. The most perfect is thirty-three inches in diameter and ten feet deep, with the top of the rim eight feet above the water at its base, or five feet and a half above the water of Long Lake. Some of the others have been partly cut away, and the smooth rock faces are strongly scored by glacial marking, showing that the pot-holes are of pre-glacial or inter-glacial age, when the water flowed in a direction more or less opposite to the course of the present river.

'A short distance below Pot-hole Portage, a small sluggish brook flows into Berens River from the north. This brook was ascended to a shallow lake almost choked with luxuriant beds of wild rice. Near the east end of this lakelet a small crooked brook was entered, which winds through marsh and willow swamp for about three miles, to a rocky

barrier eight feet high, over which the water flows in its higher stages earlier in the season. Crossing this rock by a portage fifty yards long, the descent of what is now the Etomami River was begun. At the next portage the water runs in a rill a few inches in width. The narrow winding but constantly increasing stream was then descended for about thirteen miles, between banks of rock and light-gray pebbly till, to a series of heavy rapids, just below which is a well defined sandy terrace, marking the highest shore-line of the glacial Lake Agassiz seen on the east side of Lake Winnipeg, and the eastern limit of the lacustral deposits. This limit had been determined on several of the other streams flowing into the lake, but nowhere was it so distinctly marked as here. Below this sandy terrace, the river flows between wooded banks of lacustral sand and clay, to the point where it empties into Berens River, seven miles above its mouth. The rocky bosses seen here and there, were everywhere of uniform granite and granitoid gneiss.

‘Pigeon River flows into the lake in a deep channel, a hundred yards wide, between sandy points, above which it opens into a shallow weedy lake. Around the sides of this lake were beds of wild rice, then almost ripe, on which great flocks of wild ducks were feeding. The channel gradually narrows and becomes well defined at a little rapid, where it is about forty yards wide, above which it again expands to a width of from sixty to a hundred yards with even, clay banks, six to ten feet high, wooded with tall white poplars. Low bosses of gray gneiss outcrop here and there, on which are growing small groves of oak. Pigeon River.

‘The work of ascending the stream was rather slow and difficult for the Indians rarely travel on the river, and the twenty-nine portages that we were obliged to make were often through dense burnt forest and over innumerable fallen trees. In its lower part, the banks are chiefly composed of stratified clay or sand and the channel is even and well defined, but higher up the banks are of gneiss or pebbly till. From Grand Rapids Lake, [Family Lake] Pigeon and Berens rivers, two streams of about equal size, flow westward towards Lake Winnipeg, the former discharging from the south, and the latter from the west side of the lake.’

‘Miskowow River, near its mouth, averages from forty to fifty yards in width, with water of a slight brownish tinge but not dark-brown like most of the other rivers east of Lake Winnipeg, indicating that it is derived chiefly from lakes of considerable size, in which the water has been cleared of its dark colouring matter. The banks are no Miskowow River.

very high but are usually rocky, and the water often seems to flow in a pre-existing rocky channel. Between the rocky knolls and ridges, the blue, stratified, lacustral clay that is seen everywhere in the lower country east of Lake Winnipeg forms well-defined level land, thickly wooded with white poplar, while the rocky knolls are thickly wooded with Banksian pine and oak.

Pot-holes.

'At the fourth portage up the river, three pot-holes, similar to those on Berens River, occur on the summit and south-west side of a granite knoll, and farther up the river, above the ninth portage, and about half-way between the mouths of Minago and Little Blood-vein rivers, a large pot-hole has been bored in the steep eastern side of a granite hill, the surface of which is now strongly scored by glacial markings. Sasaginnigak Lake is an irregular body of clear water lying in the midst of low hills of gray granite. From this lake there is said to be an easy canoe-route northwards to Grand Rapids on Berens River.'

Berens River
to Dog Head.

'The shore of Lake Winnipeg from Berens River south to Dog Head is composed of granites and gneisses generally striking towards the lake but at the latter point these gneisses begin to assume a very regularly banded arrangement parallel to the lake, and a few miles farther south, dykes of dark-green trap begin to make their appearance, running in the same direction. Then irruptive rocks continue close to the east shore as far south as Wannipegow or Hole River, where they merge into an extensive area of eruptive volcanic rocks and agglomerates that form the base of the Keewatin series. On ascending the streams that flow into this portion of the lake, namely, the Loon, and Rice rivers, the gneiss is seen to be very regularly and evenly banded near the eruptive rocks, while farther east it changes imperceptibly into the coarse gray irregularly foliated Laurentian gneiss typical of that whole region. The rocks of the eastern end of

Black Island.

Black Island were found to consist of altered conglomerates, quartzose sandstones, agglomerates, chloritic and sericitic schists, etc., similar to those found in the typical Keewatin in the Huronian districts elsewhere. The quartzites and conglomerates are somewhat more easily eroded than the adjoining volcanic rocks, and they therefore lie in a hollow, which is flanked on one side by Black Island, and on the other by the east shore, the beds standing generally at a high angle and striking parallel to the general curving trend of the shore.'

Wannipegow
River.

'Wannipegow or Hole River at its mouth breaks through a belt of evenly banded gneisses, above which it flows for ten or twelve miles through a rich alluvial plain wooded with poplar and white spruce,

the banks on either side rising to a height of from fifteen to twenty feet above the water. Very little rock is to be seen but any exposures that do outcrop from beneath the till and alluvial deposits consist of massive coarse amphibolites and green chloritic schists. On the lake above, the rocks are almost entirely of the same character, though at some places on the north shore the gneiss approaches close to the water, and the contact of the green schists of the Keewatin and the Laurentian gneiss is well shown. Speaking generally, the lake and valley of the river lie in a trough of Keewatin schists, the north side of which is bounded by ridges of Laurentian granites and gneisses, while the south side rises in hills of more compact green schist.

'A tributary, the English River, in its lower portion also flows over Keewatin schists, but the lowest rapid occurs at the contact of the schist and gneisses, and above this its course is through rugged country composed of high barren hills of gray gneiss, thinly wooded with a stunted growth of small Banksian pine. Specimens of galena and chalcopryite, stated to have been found on the north shore of Wannipegow Lake were shown to the writer, and the occurrence of these minerals is not improbable along the above mentioned contact line.'

'From the mouth of Wannipegow River to Manigotagan or Bad-throat Bay the shore is composed of greenish-gray evenly banded gneisses, with schists and altered traps of the Keewatin series, while near Clement Point these are overlain by Winnipeg sandstone, this latter being the most northerly point at which Palaeozoic rocks have been recognized on the east side of the lake.'

'Manigotagan River is remarkably picturesque throughout, consisting of long quiet stretches of clear brown water, separated by rocky rapids or high abrupt falls, which are passed on portages of an average length of from one to two hundred yards, twenty-three of which must be ascended on the way from Lake Winnipeg to Rat Portage Lake.'

'From the mouth of Manigotagan River to Point Metasse, north of the mouth of Winnipeg River, granites and gneisses everywhere compose the points on the shore, and these points are usually connected by gently curved sandy beaches in front of low-lying alluvial land.'

'On Winnipeg River the rocks are all granites and gneisses, but towards the east end of Lac du Bonnet and around the mouth of Oiseau River, thin-bedded green schists and altered traps, doubtless of Keewatin age, make their appearance, striking up the valley of the latter stream. Above the lake on the main river, the banks, as far as

the mouth of Whitemouth River, are chiefly composed of till, with many limestone boulders, and the rocks are scored in a south-south-easterly as well as a south-westerly direction, showing that the earlier glacier moving south-eastward over the Palæozoic Lake Winnipeg basin, had extended at least this far eastward, though there is no sign of limestone drift on the main portion of Lac du Bonnet itself or on the lower part of Winnipeg River.'

DETAILED DESCRIPTIONS OF THE COUNTRY BORDERING THE EAST SIDE OF LAKE WINNIPEG.

Playgreen Lake.

Rocks of islands in Great Playgreen Lake

Off the west point of the island lying N. 12° E., from Warren Landing are rounded knobs rising a foot or two above the water. They consist of brownish-gray gneiss, cut by a dyke of red granite six feet wide, from which smaller veins extend in all directions. The bearing of the main dyke is generally S. 56° E., but at one place it runs for ten feet at right angles to this. It is distinctly banded, being coarser in the middle, and usually finer toward the sides.

Islands south of Kettle Island.

The island south of Kettle Island is composed of dark moderately coarse-grained quartz-mica-diorite-gneiss, with a very irregular lamination, striking for the most part about N. 45° E., but in one place S. 70° E. It is composed of plagioclase feldspars, microcline, quartz, biotite, hornblende, a little augite, with apatite, zircon, pyrite and titanite. Under the microscope it is evident that plagioclase is the most abundant feldspar present, only a few untwinned grains being visible in the section. The plagioclase is much decomposed, fine tufts of kaolin and sericite occurring throughout the grains of this mineral, and in some cases the alteration is almost complete. Some of the grains show uneven extinction. Between some of the larger grains of feldspar are granophyric areas. The quartz is of the usual granitic type, much crushed, and exhibits very uneven extinction. It holds dust-like inclusions with bubbles, etc. The biotite is dark-brown in colour and strongly pleochroic, and is in part altered to chlorite, some of the grains showing complete alteration, while others show chloritization in streaks only. It holds numerous minute crystals, probably rutile, with a sagenitic arrangement. Zircon crystals also occur in it, surrounded by well-marked pleochroic halos. The hornblende is in very small quantity. Apatite occurs in rather stout crystals scattered through the section, and pyrite is found in well-defined crystals.

Microscopical character of rock.

This gneiss includes many rounded and angular masses, up to five feet in diameter, of a dark fine-grained hornblende-granitite-gneiss, containing crystals of primary epidote, the line between the two gneisses being sharply marked, though the former often shows a distinct lamellar structure around the masses of the latter. Both gneisses are cut by many dykes of red granite ranging up to fifteen feet wide, the larger ones being near the west side of the island.

Three miles north of Warren Landing is a low bushy island formed of coarse white granite, with irregular inclusions of darker gneiss.

Half a mile east of Kettle Island is a low scrubby island where the reddish-gray gneiss strikes S. 70° E.

Kettle Island is composed chiefly of gray granitoid gneiss, through which are scattered rounded inclusions, from a foot to several yards in diameter, of darker gray gneiss. On a low island a mile and a half north of Kettle Island the gneiss is heavily laminated, running S. 75° E.

On the east side of Goose Island is an outcrop of fine-grained dark-gray quartz-mica-diorite-gneiss, composed chiefly of plagioclase, biotite, quartz, muscovite, and orthoclase, with epidote, apatite, zircon, magnetite and chlorite. The rock shows distinct evidence of pressure, the quartz being fractured, and showing wavy extinction. Plagioclase is present in large amount. There are also some grains of untwinned feldspar, which may be orthoclase, and a few grains that exhibit the characteristic twinning structure of microcline.

Lithological
description.

Biotite is the principal bisilicate present, it is light-yellow to brown in colour and strongly pleochroic. Associated with it is a considerable quantity of colourless muscovite. Small zircons, showing the pleochroic halos so often noticeable, occur in the biotite. Apatite is in large, short, stout crystals. Magnetite is rather abundant. Chlorite occurs as a decomposition product of the micas.

Lying against this diorite-gneiss in an irregular line bearing generally north-and-south, is a very lamellar micaceous gneiss, striking east-and-west and almost vertical. Between the lamellæ are included many masses of darker fine-grained dioritic rock, all more or less drawn out in the direction of lamination. These various rocks are cut by banded veins of pegmatitic granite, usually running about N. 45° E.

On the east side of the island are two narrow veins, striking N. 10° E., of fine-grained dark-green compact quartz-diorite, which under the microscope is seen to consist of a fine-grained felspathic and chloritic

groundmass, through which are distributed numerous lath-like crystals of a more or less decomposed plagioclase. Quartz and augite also occur.

Islands near
Goose Island. A third of a mile north-east of Goose Island, is a small island of light-gray gneiss striking S. 85° E.

A small island almost a mile north-north-west from Goose Island is composed of a dark-gray moderately fine-grained almost massive gneiss, with a few porphyritic feldspar crystals scattered through it. It possesses a somewhat distinct lamination, striking N. 20° W., and dipping N. 70° E. < 55°. It is also cut by a series of almost vertical jointage planes running north-and-south, breaking the rock into masses from one to two feet in thickness. Some veins of red pegmatitic granite also cross this island in a direction N. 45° E.

Lithological
descriptions.

Under the microscope, the gneiss is seen to be a tolerably fresh holocrystalline rock, consisting of quartz, plagioclase, orthoclase, hornblende, biotite, augite, titanite, epidote, magnetite, zircon, chlorite, apatite and pyrite. Small areas showing granophyric structure occur between many of the feldspar grains. The quartz is of the ordinary granitic type, holds numerous inclusions, and in its fractured appearance and wavy extinction shows evidence of having been subjected to dynamic action. The feldspar occurs in both twinned and untwinned grains, many of which show more or less kaolinization; it holds numerous inclusions. Hornblende is the most abundant bisilicate present. It occurs in strongly pleochroic individuals, dark-green to lighter in colour. Many of the individuals are twinned and well defined in their crystallographic boundaries. A striking feature of the section is the abundance of titanite present in it. The epidote occurs in quite large individuals, which in some cases include apatite and magnetite. Its pleochroism is quite marked and the interference colours are brilliant.

Playgreen
Point.

Playgreen Point is a rocky promontary of dark hornblendic gneiss striking N. 60° E., cut along the lines of foliation by heavy bands of coarse reddish-gray biotitic granite.

The islands towards the north and north-west of Playgreen Point are all rocky knolls composed of very similar gneiss.

The large island near the north-west side of the bay is of a medium-grained gray hornblende-granite cut by wide veins of red pegmatite.

West of the most westerly channel into Little Playgreen Lake is a low point surrounded by rocky reefs, and composed of reddish-gray gneiss foliated N. 60° W. Catfish Point is very similar in character,

consisting of light-red gneiss striking N. 75° E. and dipping S. 15° E. Catfish Point.
 < 60° In the next seven miles along the west shore of the lake, very few exposures of rock were seen, and then the lake bends to the north around a low rocky point composed of a reddish-gray dioritic gneiss striking S. 40° E., while a number of low reefs of similar rock lie off the point. The bay to the north-east is also studded with islands of similar character. One long point near the bottom of the bay consists of reddish-gray gneiss, with some highly biotitic bands, striking N. 70° E., and dipping S. 20° E. < 60°. On the north side of the bay, where the main channel of Nelson River flows from Playgreen Lake, the rock forming the bed and sides of the channel is a well-foliated reddish-gray biotitic gneiss striking N. 50° E. and dipping S. 40° E. < 25°.

Channels between Great and Little Playgreen Lakes.

The banks of the steamboat channel consist of reddish-gray gneiss, almost massive in texture, rising in rounded bosses from the edge of the water up to the height of thirty feet. The eastern channel is very similar in character, with low rounded rocky banks of Laurentian gneiss.

Little Playgreen Lake.

Little Playgreen Lake is divided into two fairly distinct portions by a narrow strait just north of Soulier Point which is a rocky knoll consisting of gray granitoid gneiss, striking N. 75° E. Soulier Point near Norway House.

North of this point is a small island, composed, on the north side, of a dark-gray biotitic gneiss cut by many reticulating veins of a reddish granite, while along the south side of the island, and separated from the gneiss, just mentioned, by a strongly marked line of contact, is a massive red and greenish-gray, mottled, rather coarse-grained hornblende-granitite, in which are many inclusions of the darker gneiss.

Under the microscope this granitite is seen to be a thoroughly crystalline granular admixture of quartz, felspar, biotite, more or less altered to chlorite, and hornblende, with epidote, zircon, pyrite, magnetite and apatite. The rock exhibits abundant evidence of dynamic action. The quartz and felspar are much shattered, the quartz being in many instances so ground up as to form a fine mozaic. The felspar is much kaolinized, and both minerals possess very wavy and uneven extinction. The zircon is in large individuals with a curious clove-brown colour. Lithological description.

A quarter of a mile west of Soulier Point is a small island composed of red granite which is here definitely foliated N. 65° E. It also includes many large masses of the dark-gray gneiss.

Islands of
Little Play-
green Lake.

South-west of this island are other islands composed of similar and hornblende-granite-gneiss. One, a mile and a half distant, and on the edge of the open lake, being more particularly examined, was found to be a coarse granite-gneiss, with a lamination, dipping N. 50° W. < 11°, and in many places a well marked schistosity striking S. 80° E. It consists of quartz, felspar much of which is microcline, biotite, hornblende, apatite, zircon, epidote, allanite, chlorite, and magnetite. The rock presents abundant evidence of crushing, and granophyric structure is widespread. The apatite occurs as a primary constituent, in large grains, in some cases with clearly defined crystal faces, mantled by unaltered biotite. The granite is cut by a number of veins of red granite, and on the south side of the island contains many inclusions of dark-gray biotitic gneiss.

South-west
portion of
Little Play-
green Lake.

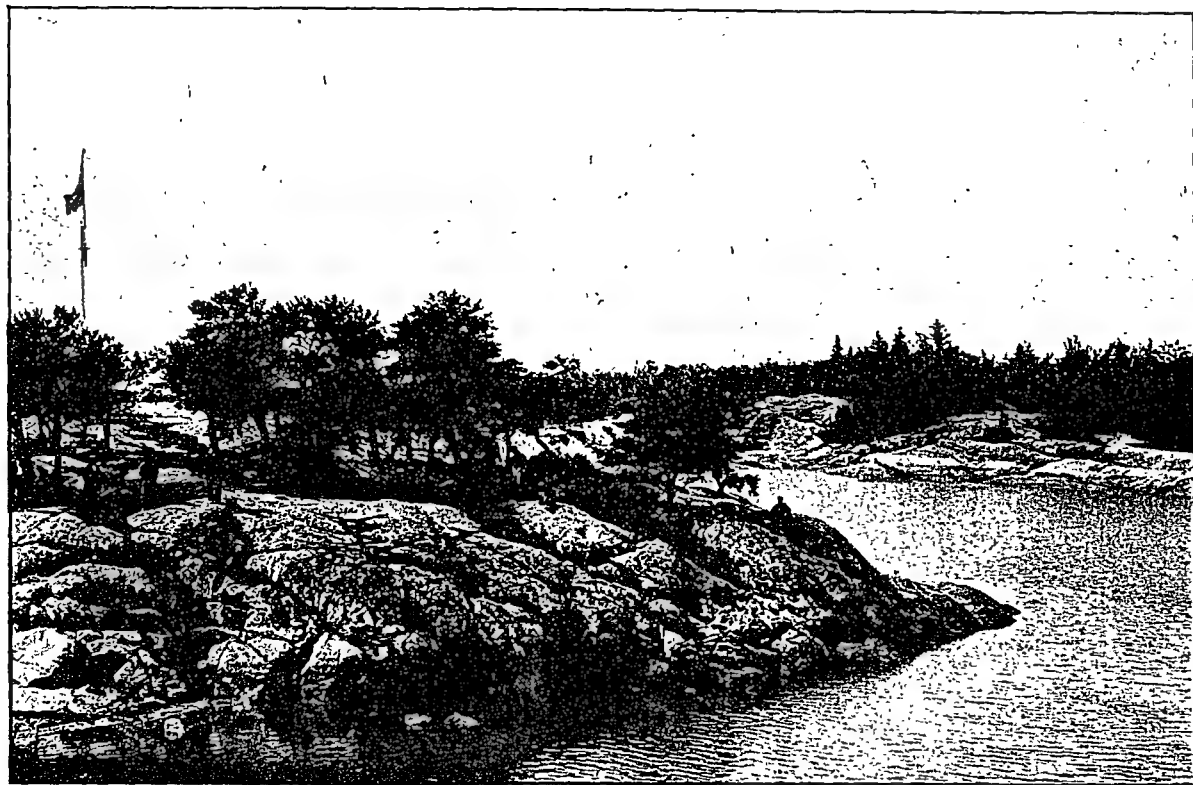
Proceeding south-westward, the south-east shore of the lake is everywhere composed of similar granite, often with darker inclusions, and almost constantly cut by veins of red pegmatite.

Six miles and a half from Soulier Point the granite was found to be cut by a dyke or mass of rather coarse-grained massive diorite or diabase.

Similar red granite extends all along the west shore of the south-western expansion and forms the shores and islands of the northern portion of the lake. On a small island nearly a mile north of Norway House, this hornblende-granite is massive, reddish and of medium grain. Under the microscope, the structure of the rock is seen to be typically granitic, and the section exhibits abundant evidence that the rock has been subjected to considerable dynamic action. Both the quartz and felspar are much shattered, forming a regular mosaic, with numerous well-defined areas showing granophyric structure and exhibit uneven wavy extinction. The felspar is more or less kaolinized. The rock is composed of quartz, orthoclase, plagioclase, hornblende, biotite, a few small grains of titanite, zircon, apatite, in well defined rather stout prisms, epidote, and a little iron ore.

Molybdenite
crystals.

Near the north end of the lake, just below where the Nelson River flows from it, the granite is cut by some veins of red pegmatite, in some of which are many rounded crystal aggregates of molybdenite, with occasional crystals of pyrite and magnetite.



J. B. Tyrrell, Photo.

VIEW AT NORWAY HOUSE, KEEWATIN, SHOWING CHARACTER OF SURFACE OF THE ARCHÆAN.

Gunisao River.

The country in the immediate neighbourhood of the mouth of the Gunisao river is very low and flat. Marshy banks extend for over a mile from the Nelson River and thence upward the country slopes very gradually, not rising much above the channel of the river till past the forks.

On the south branch the gradual slope is carried to nine miles east of the forks where a steeper ascent is met. On the lower plain a light covering of alluvial clay is seen occasionally in the depressions and has probably all been carried down by the river. On this the timber is heavier than that seen on the higher parts, and spruce up to twenty-four inches in diameter was noted. Character of country below the forks.

In the vicinity of the mouth of the river the rock is a gray granite-gneiss cut by veins of red pegmatite-granitite. The foliation of the gneiss becomes less distinct, until at the second rapid, it has entirely or almost entirely disappeared, and the rock is quite massive.

Similar gneiss underlies the country up to the forks, and thence, up the north branch of the river, it may constantly be seen cropping out from beneath the covering of clay, sometimes massive, and sometimes distinctly foliated. Two miles and a half up this branch, named McLaughlin River on the map, there is a band of medium-grained, gray, rusty-weathering-granitite-gneiss, with very distinct foliation, dipping north at an angle of 30°. At a portage two and a half miles higher up the stream, the rock is a massive granite, varying to a highly contorted gneiss.

Thence up the stream for a considerable distance the rock changes but little in general character, though it may vary somewhat in colour and texture, and foliation may or may not be noticeable.

In longitude 97° 30' W., the gray granite is replaced by a massive red medium-grained granite, which often contains included masses of dark-gray granite-gneiss, and is, therefore, probably somewhat newer in age than the latter. In some places it contains large crystals of magnetite. This red granite extends up to, and past, the first small lake, when the light-gray well-foliated gneiss re-appears, striking N. 60° E.

Near the second small lake, rocky ridges run on each side of the river; composed of a gray gneiss in which plagioclase feldspar has so largely replaced the orthoclase that the rock might be classed as a quartz-mica-diorite. It strikes S. 75° E., and has an almost vertical dip. This light-gray granite or quartz-mica-diorite, forms the shore of the second small lake, and extends for a mile eastward to where the

McLaughlin
River.

river again divides into two almost equal branches, each about fifty feet wide. The surrounding country is here exceedingly desolate, consisting of bare, low rounded knolls of reddish granite and gneiss with a general elevation of sixty feet above the river, the gneiss having a general strike N. 60° E.

The banks are low in this vicinity, and composed of gray silt for a considerable distance, but five and a half miles above the last-named lake, the river expands into another small lake, three-quarters of a mile long, in the middle of which is an island of a dark-gray and greenish, highly altered, hornblende-schist, with a foliation striking N. 55° E., but this foliation is usually very irregular, and is often replaced by an ovoidal or concretionary structure.

Magnetic
attraction.

A mile above this lakelet we passed a low hill, beside which the compass refused to work with any regularity, and a quarter of a mile higher up the stream, is an outcrop of dark-gray thinly and regularly foliated hornblende-schist, striking N. 70° E., and with a vertical dip. Its surface is very deeply weathered.

A mile above this point, and on the west side of the river, is a rounded hill sixty feet high, of light-gray thinly-foliated garnetiferous muscovite-granite-gneiss, rather irregularly interbanded with dark-gray hornblende-schist or biotite-schist, all striking N. 75° E.

For nine miles above this point, the river continues to come from an east north-easterly direction, following this band of schist, which crops out here and there along its banks.

Robinson
Lake.

Robinson Lake, from which the river takes its rise, lies in a depression from which these schists have been worn out, and hornblende-schist, occasionally with interbedded granite veins, everywhere forms the shore of the long narrow lake. From the upper end of the lake the same valley continues in an east north-easterly direction an unknown distance, doubtless following the trend of this band of schist.

Gunisao
River above
forks.

Ascending the south branch of Gunisao River the banks are at first of clay and very little rock is exposed. Five miles above the forks is a rounded boss of light-gray massive biotite-granite; although as plagioclase would seem to be the chief felspar constituent, it might perhaps be classed as a quartz-mica-diorite. Similar granitite outcrops rather more than half a mile higher up the stream, and again two miles and one-fourth above. At a thirty yard portage this granitite exhibits a slight gneissic foliation.

Three-quarters of a mile higher up the stream are banks of rather high rounded rocks over which is a portage one hundred yards long.

The rock is a massive, coarse, gray granitite or quartz-mica-diorite with here and there included masses showing gneissic structure.

Across the west side of the knoll this rock is cut by a narrow dyke, averaging fifteen inches in width, dipping vertically, and striking N. 23° E. Branches several inches wide constantly run off into the surrounding granitite and end abruptly. The dyke has a strongly marked columnar structure, running transversely from wall to wall. The dyke-rock is an augite-porphyrite of a light greenish-gray colour. It has a mica-felsitic groundmass in which sericite is abundantly developed, giving the rock its colour, and through this are scattered many little bright phenocrysts of light-coloured pyroxene (augite) more numerous near the sides of the dike than in the middle, a few small and irregular phenocrysts of plagioclase, many small rounded crystal aggregates of arsenopyrite, and some secondary muscovite and zoisite. Rocks at various portages.

At another thirty-yards portage, a mile and a quarter above the last portage, the rock is again a massive light-gray quartz-mica-diorite. At the next portage three miles and a half above this the rock is a massive medium-grained biotite-muscovite-granite, of light-gray colour very similar to the quartz-mica-diorite previously found.

The banks above this portage became more bare and rocky than below it, and the quartz-mica-diorite becomes distinctly foliated; at the portage (twenty yards) it strikes N. 80° E. and dips S. 10° E. < 30°.

For eight miles above this portage, to the next portage which is thirty yards long, the rock is everywhere a very similar gneiss, with essentially the same strike throughout the distance. On the north bank is a cliff twenty feet high, showing at the top eight feet of fine, gray sandy clay apparently with very few boulders, and below it for several feet and probably to the water, is well stratified sand and coarse gravel; the pebbles being from the Laurentian rocks. The country just passed through appears to be largely of the nature of a sand-plain through which the river has cut a small valley.

Rather less than half a mile above the last portage is a Falls. fall with a drop of eight feet, at which the rock is a light-gray medium-grained granite showing in a few places a very slight foliation striking N. 70° E. Three miles higher up, the river again falls over a fine-grained light-green granite which is usually slightly foliated, N. 80° E. Half a mile above is another fall, past which is a portage three hundred yards long. The rock is a similar gneiss, in

places thinly and clearly foliated, and in others obscurely foliated the strike varying from N. 35° E., at the west end to N. 80° E. at the east end of the portage.

Wooded
plains.

For the next six miles very little rock is seen, the river running through rich wooded plains rising gradually and varied here and there by rocky knolls, but above this the rock becomes the predominating feature and the plains are merely the bottoms of the shallow depressions between the hills. Boulders continue to be rare, and sand is seen here and there, but the depressions in the rock appear to be almost everywhere filled by a very light-gray, fine, almost impalpable clay. Instead of large spruce, with white and black poplar, the whole country is thickly overgrown with small black spruce, which a few years ago was killed by fire, so that now there is nothing but blackened stems with a thick growth of underbrush. The first exposure in the rocky part is at a succession of small falls over a foliated reddish-gray gneiss, with vertical dip, and a general easterly strike. The banks now become bold and rocky, and continue so for a considerable distance. At a portage seventy yards long, two miles higher up the river, the rock is a gray quartz-mica-diorite, of medium grain, and well foliated, striking east and with nearly vertical dip.

Rocks near
Gunisao Lake.

Two miles and a half above this portage, in latitude 53° 35' 10", is a boss of gray moderately coarse-grained garnetiferous quartz-mica-diorite, associated with a red granite of medium grain. The burnt country ends about five miles above this, and is succeeded by a tamarack swamp through which rise many low rounded bosses of granite. For all the rest of the way up to Gunisao Lake, a distance of about thirty-five miles, the river winds between banks composed of massive, gray quartz-diorite, which forms low rounded hills, seldom rising more than thirty feet above the general level. After the river turns south-eastward toward Gunisao Lake, the country begins to look a little more pleasant, with Banksian pine and white poplar along the banks and on the rocky knolls. The white clay disappears and a few perched boulders are, for the first time on this river, seen resting on some of the rocky knolls, all of rock similar to that beneath, showing very little transportation.

Three miles below the lake, the diorite is cut by two dykes, six feet in width, of dark-green fine-grained gabbro, striking S. 80° E., and dipping S. 10° W. < 75°. Along the edges they show distinct traces of foliation, but towards the middle they are quite massive. In the specimens of this gabbro collected, the augite was found to have been entirely altered to hornblende.

The south shore of Gunisao Lake rises either in steep cliffs to a Gunisao Lake height of from thirty to fifty feet, or is low and flat, the rock sloping gently to the water. The bays have a beach of rounded boulders and the rock can be seen in many places to be overlain by a light-gray clay with angular stones and many rounded boulders, all from the Laurentian rocks. Glacial grooving may be seen in many places, but the rock is so much weathered that only the coarser markings remain. The whole country is thickly covered with black spruce. The north shore is much more rugged than the south side, and has very little vegetation on it. It is also skirted by fewer islands and indented by less irregular bays. The rocks exposed are everywhere of similar coarse gray quartz-mica-diorite, which is often vertically jointed, thus forming steep or vertical cliffs. At one place near the north-eastern end of the lake, a slight foliation was observed in the diorite, with a strike S. 75° E.

On Gunisao River, above the lake, the rock is, at first, a diorite similar to that on the lake, but it soon becomes more acid, and changes into, ^{River above lake.} or is replaced by, a reddish massive, often garnetiferous granitite.

The shores of Kapmatasko Lake which lies to the south-east of Gunisao Lake, are generally low, and at the points show low outcrops of this granitite, which is almost everywhere massive, but at one point near the north end of the lake it showed a slight foliation striking N. 70° E.

Shore of Lake Winnipeg—Nelson River to Dog Head.

Beginning at the head of Nelson River, and proceeding southward, the shore is usually composed of low cliffs of stratified post-glacial clay and peat, with rounded bosses of rock projecting here and there from beneath it, and often skirted by many low bare rocky islands.

Two miles south of Nelson River the rock is a coarse reddish horn-^{East shore near Nelson River.}blende-granitite-gneiss, without well-defined schistosity, but in bands differing slightly in colour and fineness. These bands have a general strike N. 85° E., and an almost vertical dip.

Montreal Point is composed of a rather fine-grained dark-gray ^{Montreal Point.}granitite-gneiss, with an even parallel foliation trending N. 70° E. In many places this gneiss is cut by wide anastomosing veins of coarse light-gray granite holding crystals of tourmaline, &c. In places the granite forms the greater portion of the mass of the rock, the darker gneiss appearing as irregular inclusions scattered through it. Both

the granite and the gneiss are again cut by smaller granite veins. A number of small rocks of similar granite or gneiss lie off this point.

Glaciated
surfaces.

The surface is beautifully smooth and rounded and shows parallel striae running S. 35° W. In one place, for about three yards in width, there is a more or less regular set of grooves running N. 45° W., rising up to the top of the knoll and then vanishing. They overlie the others and point directly out into the lake. They have been caused by the shoving of a single mass and may possibly have been recent, but as the shove would appear to have been toward the lake, this does not appear probable. Numerous little islands lie off the points to the south for some distance, though the points themselves are mostly of sand. For the rest, the shore is mainly sandy, though occasionally scattered with a few pebbles and boulders. The boulders are all of gneiss and granite, but a few of the pebbles are of cream-coloured dolomite. Behind the beach is a cliff gradually declining southward from eighteen to eight feet, but its face is piled with drifting sand and there is often a little sand dune along the top. A mossy muskeg with spruce and tamarack stretches everywhere backward from the lake.

Stratified
deposits.

The shore, south to Spider Island Point, is being cut into by the waves, and now shows one to two feet of stratified beach-sand overlying a little vertical cliff two feet high of stratified, blue, tenacious clay breaking out into little angular fragments. Just north of the point similar gray granite, often with a green tint but with no inclusions, is cut by many veins of red granite. High sand-dunes are piled up at the edge of the woods. A little rill of brown water here runs into the lake.

Farther south, the shore is similar, being low and flat. The beach is covered with sand without boulders. Much of the beach is underlain by clay, while tree trunks erect and projecting at the edge of the water, probably indicate erosion into an old swamp. The land declines so that it is but two feet above the water, becoming a mossy muskeg that reaches Spider Island Point.

South of
Montreal
Point.

Four miles south of Montreal Point is a light-gray coarse-grained compact granitite, in which are many inclusions of a darker finer-grained granitite-gneiss, these inclusions being almost all arranged in strings in an east-and-west direction. Some small veins of red granite run parallel to these, and beside and parallel to them a certain amount of schistosity is often developed in the light-gray granitite. Other narrow veins of red granite also cut the rock very irregularly. The surface is smoothed and shows many glacial striae running S. 35°

W. The bottom and the water here is very muddy, much more so than to the north.

A point two miles farther south is composed of similar light- and dark-gray granitite, which is cut by anastomosing and crossing veins of red pegmatitic granite, breaking the rock very irregularly. Three series of these veins were recognized, the newer slightly faulting the older ones. Their general directions were as follows:—First and oldest, S. 50° E.; second, S. 45° W.; third and newest, S. 10° W. Three series of veins.

At the next point, in latitude 53° 33', similar rocks, cut by granite veins, also occur. One dark band, here composed of hornblende-granitite-gneiss, is eight feet wide, and dips N. 40° E. < 35°. Along its contact with the surrounding gray granitite, and along little fissures cutting across it, epidote is largely developed. Spider Island Point.

At Spider Island Point, in latitude 53° 30', the rock is a dark-gray epidote-hornblende-granitite-gneiss, with a slightly greenish hue on the weathered surfaces. In general character it is very similar to the granitite-gneiss seen so often along the shore farther north, and has a well-marked strike varying from N. 35° E. to N. 50° E. A quarter of a mile north-east of this point the gneiss is cut by two narrow vertical dykes or veins of green hornblende-schist striking N. 80° E.

At the mouth of a little creek, a mile south-east of Spider Island Point, similar granitite forms the shore, in some places quite massive, and in other places well foliated, though the strike of this foliation is very irregular. Many veins of red pegmatite cut across the granitite, and the foliation often bends round toward the veins.

A few narrow vertical bands, or long lenticular masses of dark-gray thinly-foliated epidotic hornblende-granitite-gneiss cross through the granitite in a direction S. 85° E. At several points between this creek and the mouth of Belanger River, similar gray gneiss juts out in rough-topped knolls. The foliation, which is more or less nearly vertical, is distinctly marked, some of the layers being much darker and more micaceous than others.

The Spider Islands, which lie from one to two and a half miles off shore, are bold granitic rocks rising abruptly out of the lake. The largest, which was that particularly examined, is composed of a well foliated, gray granite-gneiss, with darker and lighter bands through which run little veins of red pegmatitic granite. The foliation is much contorted, but seems to have a general strike S. 40° W., parallel to the longer diameter of the island, while its dip is approximately vertical. Across the narrow neck connecting the Spider Islands.

two ends of the island the gneiss is cut by a straight vertical dyke, from two to four feet wide, of dark-green schist, probably resulting from a diabase. This schist, being softer than the gneiss, is much weathered away, leaving a sharp gash through the neck of the island.

Rocks south
of Belanger
River.

Half a mile south of Belanger River is a point composed of gray granitite-gneiss, the foliation of which appears to strike about N. 45° E., and to dip at an angle of 70°. On the south side of the point the foliation is not so pronounced, but there is a fairly definite line arrangement of the crystalline constituents of the rock, which gives the surface a fibrous or thread-like appearance. Veins of coarse red pegmatite are common throughout the rock, and the gneiss is also cut by a vein or dyke from eight to ten feet wide, of moderately fine-grained red granite.

A mile from this, up the shore, there is a projecting ridge of rock composed of a coarse, gray granitite-gneiss, sometimes showing a slight foliation striking N. 5° E., but often massive. Veins of both fine and coarse red granite cut this gneiss.

Belanger
Point.

Belanger Point is also composed of a similar granitite cut by granite veins. The surface is weathered rough, but the glacial grooves are seen running S. 18° W. The direction of striation changes slightly along the shore here from the north, since at Montreal Point the direction was nearly S. W.

Rocks of shore
south to Big
Black River.

At a point in latitude 53° 24' 30", a boss of coarse, red pegmatitic granite projects 250 feet from the shore. It contains white mica, either as small radiated masses, or as individual crystals up to five inches in length. On the south side of the boss the rock assumes a very coarse, brecciated appearance, and sixty paces farther south it is usually finer-grained and exhibits a more or less distinct foliation, and also contains angular inclusions of gray gneiss.

The shore all along is low and sandy with a low marshy country behind. The stream that flows in here is only eight feet wide where it crosses the beach, but most of it reaches the lake through the sand. 270 paces farther south coarse, gray gneiss again forms the shore. This gneiss is sometimes almost massive, but it includes some bands of highly micaceous gneiss. It is cut by veins of red granite.

In latitude 53° 23' 30", the points consist of greenish-gray, coarse, quartz-mica-diorite, which is usually massive, though occasionally exhibiting a slight foliation that varies in direction from north to north-west. Included in it are a few small stringers of coarse mica-schist or granitite. Pegmatite veins are notably rare, but one coarse

vein contains, along its middle line, many fine large crystals of white mica. The diorite is also cut by some bands of light-green epidote.

Half a mile farther along the shore, pegmatitic veins again become fairly numerous, and among them is a vein of fine-grained granite-porphry from one to two feet in width. The diorite is also here cut by a band eighteen inches wide of dark hornblende-schist, striking N. 32° E., and 400 yards farther north-east is a band of hornblende-granite striking N. 75° E., while the diorite itself has an indistinct foliation N. 15° W.

Between
Belanger
Point and Big
Black River.

At a point in latitude 53° 22' 30", low reefs run out. The rock here has a rough surface, but 300 yards back there is a low outcrop of gneiss the surface of which is beautifully planed and glaciated and not weathered, having been comparatively lately uncovered from its mantle of hard, blue clay. Most of the glacial striæ run S. 26° W., but in two places the smooth surface with these striæ cuts an older smoothed surface at a sharp angle. This surface is also striated though the striæ are not so fresh and clear as the others and run S. 48° W., making thus an angle of 22° between the two sets.

A point in latitude 53° 21' 45", is composed of gray dioritic gneiss, without pegmatite veins, but the gneiss includes masses of darker gneiss drawn out in a direction N. 85° E., and similar conditions prevail at a point a mile farther south, though the inclusions here usually lie N. 35° W. Three-quarters of a mile farther south, a band of similar dark-gray gneiss runs N. 60° W.

In latitude 53° 21' is a low clay point from which shallow water with a soft clay bottom, stretches out for a long distance. This is protected by innumerable little bare granite reefs lying off the shore and in the bay to the south. Behind the point is a mossy muskeg with about two feet of peat underlain by blue clay. There are very few boulders in the shallow water, but a number are collected around a rocky boss, south of the point. This is composed of massive gray granite, in which there are a few inclusions of a darker colour drawn out N. 15° W. The next point south is formed of massive, gray gneiss with a *roche moutonnée* surface roughened by the weather. It is cut by one narrow band of fine-grained dark gneiss striking N. 60° W., but it has no inclusions and no veins of red granite. Like all the other exposures, its lee side is abrupt and broken, while the stoss side is rounded. From this point southward for several miles the shore is shoal, but the numerous rocky islands seem to be all composed of gray gneiss similar to that farther north, cut by few, if any, veins of pegmatite.

In latitude $53^{\circ} 16' 15''$, the rock is a coarse-gray granitite or quartz-mica-diorite, without distinct foliation, but containing a few darker inclusions drawn out in a direction N. 65° W., and traversed by a very few narrow veins of coarse red pegmatite.

For four miles southward the rock is a similar gray gneiss, occasionally with a distinct foliation varying from N. 45° to 65° W.

Spotted rocks
near Ducks
Nest.

At a point called Ducks Nest there is an area of spotted rock about thirty feet in diameter, in the gneiss, having the appearance of a conglomerate in which the pebbles are a dark-gray gneiss, while the matrix is a lighter gray running in narrow bands between, and being harder, stand out in little ridges. The pebbles are lenticular, being sometimes a foot or more in length, and lie north-and-south, or nearly transverse to the strike of the gneiss. The appearance of the rock suggests a similarity to the so-called leopard rock. Dr. A. E. Barlow thus describes it:—

Lithological
description by
Dr. Barlow.

‘The hand specimen shows a dark-gray, medium-textured rock, traversed by small pegmatite-like dykes of coarse, reddish to greenish epidotic granite, the whole apparently representing a complex intrusion of one rock through the other, the granite evidently being the latest. Under the microscope, the most basic phase of the rock shows a holocrystalline admixture, composed chiefly of hornblende and plagioclase, together with a considerable quantity of epidote (much of which is doubtless primary), and biotite. The hornblende is the most abundant constituent, and occurs in irregular, cleavable, compact masses showing the usual trichroism. The biotite has undergone “bleaching” as the result of the removal of a considerable part of the iron, and as a consequence exhibits brilliant chromatic polarization between crossed nicols. It often occurs embedded in and sometimes completely surrounded by the hornblende. The felspar has undergone “saussuritization,” and much of it, judging from the nature of the decomposition products, must be a plagioclase near the basic end of the series. Epidote is very thinly scattered through the slide, and besides being present as a product of alteration of the felspar, likewise occurs in tolerably sharp individuals enclosed in the hornblende. Quartz is only sparingly represented, as is also sphene. Apatite is abundant, while magnetite and pyrite are both present. The rock is a rather typical epidotic diorite, and may have resulted from the alteration of a gabbro.

Basic phase.

Intermediate
phase.

‘The slide representing the intermediate type of rock, differs from the preceding, in that biotite is the prevailing coloured constituent, and is associated with a large quantity of epidote, some of which is secondary, resulting from the alteration of the felspar, but a large pro-

portion is evidently original. A small amount of hornblende is present in addition to the mica, which latter mineral has undergone extreme bleaching and chloritization. Felspar is relatively more important, but it is difficult to say whether plagioclase or orthoclase prevails. Some of the iron ore at least is ilmenite, as it is partially decomposed to leucoxene. Pyrite is present often in well-formed cubes.

'In the section of the most acid type of rock which was the last Acid to crystallize, the principal constituents are orthoclase, plagioclase, quartz, biotite and epidote, together with magnetite, sphene and zircon as accessory minerals, and epidote, zoisite and sericite as secondary products of decomposition, chiefly of the felspar. The bleached biotite is in places almost all gone to chlorite, and every stage in the process of alteration may be seen. The felspars are very much decomposed and filled with the usual saussuritic products. In the twinning of the plagioclase both albite and pericline laws are represented. The quartz is abundant in irregular areas showing beautiful undulatory extinction due to pressure. The rock is an extremely altered epidotic granite.

'The three slides examined represent magmatic differentiation in a very beautiful and perfect manner, the most basic form being a mica-diorite which has doubtless resulted from the alteration of a gabbro which contained biotite in addition to the original augite. The minerals in all three sections are essentially the same, differing only in their relative abundance.

'Most of the epidote, which is especially abundant in the most acid phase of the rock, but which is also plentiful in all the slides, is doubtless original, and the first of the coloured constituents to crystallize out, being embedded in the biotite, which is in turn enclosed in the hornblende. The large hand specimen shows in what is believed to be a very typical manner the method and order of crystallization resulting from the slow cooling of a deep-seated magma of heterogeneous composition.'

Behind the point where the spotted rock occurs, the gray granite is cut by thin veins of black tourmaline.

The same gray granite-gneiss forms the point in latitude 53° 12' 30", and foliation is everywhere apparent in a north-and-south direction, either as a linear arrangement of the mineral constituents or inclusions, or as a slight difference in colour and composition, and similar gneiss extends down the shore to Big Black River.

At the mouth of Big Black River the rock is a similar gray granite-gneiss, cut by veins of fine-grained dark-reddish granite, and

Rocks at Big Black River.

also by two narrow veins or dykes, a foot in width, of green felspathic actinolite-schist. These dykes have a general trend N. 25° W.

The same granitite-gneiss, usually without pegmatite veins, forms the shore of the bay for three miles and a half south-west from Black River. Near the point south of the bay the granite rock becomes a thinly foliated crushed granite with a regular strike N. 50° E. From this point southward to Poplar River the shore is fringed with many small rocky islands, which seem to be all of gray gneiss, in which granite veins become much more common as Poplar River is approached.

Rocks at
Poplar River.

Near the Hudson's Bay Company's trading store at Poplar River, the rock consists of a greenish-gray epidotic granitite-gneiss, with, in places, a fairly well-defined foliation striking N. 35° W. This gneiss is usually rather fine-grained, but near the edge of the river it became very coarse-grained and much more massive. In this vicinity the gneiss is cut by several veins of soft, green, chloritic schist, which are probably highly altered forms of some eruptive rock. The rock is in many places covered by from two to four feet of a soft dark-blue clay, apparently without pebbles and probably deposited in the water. In it are numerous small concretions of calcareous matter. The rock is beautifully and apparently quite freshly striated, but this freshness is here due to the recent removal of the clay covering. The striae run S. 40° W. but on one protected smooth surface they run S. 48° W. while at the same time a few shallow broken grooves probably made by the lake ice, run S. 15° W.

Glacial striae.

Similar green granitite-gneiss forms the south shore of the bay for three miles west of the mouth of Poplar River, beyond which, to Poplar Point, the bay is literally filled with little islands of bare gray granitite.

Rocks at
Poplar Point.

At Poplar Point the rock is generally a hornblende-granitite-gneiss well foliated in light and dark bands, with a regular strike N. 50° W., and a dip at a high angle S. 40° W. It includes a few irregular masses of dark mica-schist. It is also cut by a great number of both wide and narrow veins of red granite, the wide veins being fine, and the narrow ones coarse-grained.

The point itself is composed of a mass of high rounded knobs of granite, wooded with stunted Banksian pine, birch and poplar, while across a deep channel, two hundred yards wide, is an island with a precisely similar surface. Through this channel the York boats pass on their way up and down the lake. Just south of

the point is a considerable number of boulders and the rock is glaciated but the marks are mostly weathered out. However, a number of grooves are seen in places running S. 37° W. Some wooded islands lie north of the point, while scattered bare islands lie off shore for a couple of miles.

A prominent point, a mile and a half farther south, consists of con- Points south of Poplar Point.
torted gneiss with dark- and light-gray bands intricately folded together; but a short distance back from the shore the strike becomes much more regular, trending N. 40° E. and dipping N. 50° W. at an angle of 30°.

A point in latitude 52° 55', in the bottom of the bay south of Poplar Point, is composed of beautifully foliated light- and dark-gray granitite-gneiss, having a general strike S. 60° W. and a dip N. 30° W. at angles of from 15° to 45°. It is cut by many veins of red granitite, a considerable number of which follow the lines of foliation. Beside one of the veins of red granitite was a vein of dark-gray hornblende-granitite. The surface is rounded but the stræ are generally weathered out. They are, however, seen running S. 25° W. The shore to here has been generally low and sandy with a few weathered bosses of similar gneiss, both on the beach and a short distance out in the lake. The land behind is all low and apparently a cranberry marsh. In the distance is a spruce forest. A little turf was seen in one place but no clay.

Similar granitite-gneiss outcrops in numerous exposures along the shore to about two miles south of Marchand Point, south of which, for nine miles, the shore is an even sandy or stony beach, without any outcrops of the underlying rock.

At Marchand Point the land behind is all low with a high ridge of sand behind the beach. The south-western side is surrounded by a closely packed boulder-pavement of rounded boulders, chiefly gray granite, this being the most boulder point northerly on this side of the lake. The land on the point is about eight feet above the lake. Just to the south of the point is an island composed entirely of boulders. The low land stretches south to past Big Stone Point, and that point is only a small promontory of Archæan boulders with no bed-rock in sight and is thickly covered with driftwood derived from the wear of the face of the swamp to the north. The boulders are composed of gray and greenish, massive gneiss with some of red granite and a few of lamellar schist. One, eighteen inches in diameter, of greenstone conglomerate was observed, but two of the Boulders point.

largest from fifteen to twenty feet long are composed of reddish-gray massive gneiss cut by veins of coarse red granite. They are about eight feet high and one is broken.

In latitude $52^{\circ} 43'$ three or four smooth rocky bosses rise about two feet above the water, consisting of dark-red granite-gneiss with a slight foliation N. 65° E., cut by thick veins of a lighter red, coarse- and fine-grained pegmatite.

Mossy Point. Low reefs of reddish-gray granite-gneiss lie off the point in latitude $52^{\circ} 38'$, one of them containing many elongated inclusions of dark-gray hornblende-schist. Thence southward for two miles several small outcrops of similar gneiss occur, after which, for several miles past the mouth of Leaf River, the beach is composed entirely of sand and boulders, but to the point of Sandy Bar, low rocky reefs, apparently of gneiss, lie here and there off the shore.

South of Sandy Bar some rather high bare rocky islands, composed of massive reddish-gray granite, extend inwards towards Berens River.

Mouth of Berens River. Near the trading store of the Hudson's Bay Company, on Berens River, the rock is a reddish-gray granite-gneiss in thin and very much contorted bands. At the point, a dyke of dark-gray, highly altered eruptive rock, cuts the gneiss, and strikes in a general way parallel to the river, appearing on several of the points in the vicinity. On the south side, the gneiss is very much contorted, but apparently with a general strike N. 60° E. It is also cut by a vertical dyke, two feet wide, of hard, green gabbro-diorite running N. 45° W.

Along the south side of Berens Bay, the first large island is composed of dark-gray, well foliated gneiss, varying in the different bands from a granite to a hornblende-schist. It is usually fine-grained, but large felspar crystals are drawn out along the lines of foliation. It appears to have a general dip N. 50° E. < 45 , though in detail it is very much contorted.

Flathead Point. Flathead Point is composed of a light-gray granite-gneiss striking N. 40° W., and with an approximately vertical dip, cut by many veins of red pegmatite.

Pigeon Bay. The northern and eastern shores of Pigeon Bay are for the most part low and sandy, with occasional low outcrops of similar granite-gneiss, often riddled with pegmatite veins.

The south shore of the bay is much bolder and more rocky, being composed of a coarse-grained, greenish-gray granite, usually massive,

and containing a few inclusions of a darker gneiss. But few pegmatite veins are seen. Just east of Pigeon Point the granite is cut by an irregular, disjointed dyke of dark-gray diorite. At Pigeon Point the granite, while usually massive, occasionally shows a well-marked foliation striking N. 50° E.

For four miles south of Pigeon Point, the shore is low and sandy, and from beneath the sand, peep out many little low exposures of massive, dark-gray mica-diorite, often cut by large veins or masses of gray, red-weathering compact granite. The diorite extends a short distance farther south and then, at Catfish Point, is replaced by a gray, well-foliated, granite-gneiss striking east and with vertical dip.

Half a mile south of Catfish Point, the foliation of the gneiss strikes N. 45° to 75° W. The gneiss includes many elongated masses of dark-gray schist, the foliation running around these inclusions, often giving the rock a very irregular brecciated appearance. A mile farther south the gneiss contains many inclusions of dark-gray diorite-schist, some of which are altered to chlorite-schist. Similar rock continues along the shore to Catfish River.

Seven hundred and fifty paces south of Catfish River, the point is composed of coarse-grained hornblende-granite, traversed by irregular veins running into larger masses, of a redder finer grained granite. Two hundred and sixty paces farther south, a reddish hornblende-granite is in sharp contact with a darker hornblende-granite, both being usually massive, but showing traces of foliation in some places. On the beach, six hundred paces farther, a gray coarse-grained granite-gneiss is exposed and extends three hundred paces farther where it is distinctly foliated N. 50° E., with a vertical dip.

Half a mile south, in latitude 52° 7', the rock is an intimate mixture of rather fine-grained granite or granite, and coarser diorite, cut by veins of red pegmatite. At the point half a mile still farther, the rock is light-gray hornblende-granite, with very few inclusions, and occasionally showing an obscure foliation S. 85° E.

Similar gray hornblende-granite outcrops here and there along the shore of the bay to Flour Point.

Many low rocky reefs lie off Flour Point, and they, with the point itself, consist of coarse red granite, with many large porphyritic crystals of orthoclase. Through it are running two straight veins or inclusions, one to two feet wide, of dark-gray granite-gneiss. In other places there are many inclusions of dark-gray fine-grained granite, almost always cut by pegmatite veins, thus giving it very much the appearance of the 'leopard rock' (p. 26G).

South of Flour
Point.

Three-quarters of a mile south, is a point composed of dark greenish-gray, massive, coarse quartz-augite-diorite, cut by wide and narrow veins of red pegmatite. This dark basic rock is again succeeded by massive red granitite similar to that at Flour Point.

For three miles farther, south-east along the shore, there are occasional outcrops of similar red and gray granitite. In latitude $52^{\circ} 2'$, the rock is a very acid, red granitite-gneiss, distinctly foliated N. 50° E. Three-quarters of a mile south-east, is a point composed of a dark bluish-gray, light-weathering hornblende-granitite, without foliation, but cut by a few veins and lenticular patches of red pegmatite.

Seven hundred paces farther south-east, the rock is an evenly foliated quartz-mica-diorite, very much cut and broken by granite veins. One of these, two feet in width, is a dark-gray porphyritic hornblende-granitite, similar to the rock at the last point.

At Split-rock
Creek.

At the mouth of Split-rock Creek, and along the shore for half a mile to the north and three-quarters of a mile to the south, the rock is composed of a very red massive granitite, in some places very compact, and in others, cut by veins or masses of dark porphyritic hornblende-granitite; these are again cut by smaller veins of red pegmatite.

South of the mouth of a brook, in latitude $52^{\circ} 0' 30''$, the shore becomes much bolder, being composed of a reddish granitite-gneiss, with a dip north at an angle of 55° . In a few places this gneiss is inter-laminated with a dark-gray hornblende-schist. The rock preserves this character for half a mile along the shore, and then again becomes more massive and less distinctly foliated.

South of
Split-rock
Creek.

On the south side of the little bay, the rock is again a coarse, red and dark-gray granitite without any signs of foliation. At the point south of the bay, and for half a mile or more to the south of it, bands of dark-gray and light-red granitite together form the shore, being separated by sharp lines, which run S. 85° E. The rocks are usually massive, but near the junction the red granitite is foliated parallel to the line of contact. Farther south the two become intimately mixed together, though the gray predominates, and gradually becomes foliated in the above direction.

The point in latitude $51^{\circ} 58'$ is a reddish granitite-gneiss, of uniform grain, and with a somewhat indistinct foliation striking westward. It is cut by one wide pegmatite vein along the line of strike but by very few smaller veins.

In latitude $51^{\circ} 57'$ the rock is a rather dark reddish-gray granitite. No foliation is apparent, but on the south side of the point a some-

what redder granite abuts against the last. Both are of about the same texture, and the difference in composition of the two is probably slight. A similar massive reddish-gray granite forms the next point to the south.

On the north side of Rabbit Point, the rock is a similar massive, dark-gray, granite, without inclusions, but cut by a few veins of coarse, red pegmatite, from two to ten inches in width. These are composed chiefly of clear quartz, and salmon-coloured orthoclase, but some large crystals of biotite are also present, and one vein contained some crystalline masses of purple copper ore. Similar, coarse red granite extends around Rabbit Point, and along the south shore of Bloodvein Bay to the long point in latitude $51^{\circ} 50'$, east of which the shore is low and swampy. The rock is usually quite massive, but is often cut by vertical and horizontal jointage planes, and thus forms a steep and bold shore. At the last-named point the rock becomes distinctly banded in lighter and darker bands, with a strike N. 25° E.

The islands and the south shore of the bay are also composed of similar coarse red granite, which is either massive, or has a slight foliation, distinguishable on weathered surfaces by the more or less evident linear arrangement of the constituent minerals.

Belanger or Little Black River.

The river up to the first rapid, a distance of nine miles, is without noticeable current, and varies in width from sixty to one hundred yards. The banks are clay, from six to fifteen feet high, wooded with white poplar and black spruce. Very few outcrops of rock are to be seen, but at the fall, which is of eight feet, there is a ledge of medium-grained, gray granite, cut by veins of red pegmatite. Above this the stream is narrower, being only from thirty to fifty yards wide, with banks usually overhung with willows. The water is both dark-coloured and muddy. From this portage the clay-banks continue to rise gradually until at the next portage they are eighteen feet above the water, and the surrounding country is an apparently level plain. Below the portage the forest is green, but above, it has been burnt over, apparently some time ago. The rock outcropping at the portage, which is ten miles east from the mouth of the river, is a massive, gray quartz-mica-diorite precisely similar to that seen on the south branch of Gunisao River. Outcrops of this gray diorite occur here and there along the river banks, and at the next portage, three miles above the last, it is cut by a dyke of dark-green hornblende-schist, one foot in

width, striking S. 15° W. The next two rapids are also caused by similar dykes cutting across the diorite, which has become distinctly foliated, striking with the general course of the stream.

Massive rocks. Near the mouth of the south branch of this stream, massive reddish-gray granitite appears for a short distance, and the massive quartz-mica-diorite re-appears on the upper reaches of the stream. The country through which this stream runs appears to be very generally covered by a thick deposit of clay and is well wooded. Isolated hills appear on the south side below the north branch, and these are of rock protruding through the clay plain. For the rest of the distance up the north branch, as far as explored, the quartz-mica-diorite is everywhere the prevailing rock, usually massive, but occasionally with a slight foliation or linear arrangement of the crystalline constituents. In places it becomes somewhat more acidic and should perhaps be more properly grouped with the granites. The small stream followed above the forks becomes very narrow and branches again. The channel is narrow and often very much obstructed by boulders, with many impassable rapids around which it is necessary to portage. The banks are rocky, overlain by silty clay, and the general character of the country is a moderately even plain with little rounded rocky knolls rising a few feet above the surface. Green timber is again seen in the upper reaches of the stream, but it appears to be of little value.

Big Black River.

Big Black
River.

The late A. S. Cochrane in the summer of 1882 surveyed as much of this and Poplar River as is shown in full lines on the accompanying map. In his note books the rock almost everywhere is said to be a 'dark-gray massive gneiss' probably a quartz-mica-diorite or a basic granitite. His notes give the following general description:—
'For a mile above the first portage the rock is all a coarse, gray gneiss. Since passing the mouth of Rice Lake branch, most of the points at bends of the river and all at the rapids, are of gneiss which has a greenish tinge on new fractures. All along the river the soil is excellent, being a light-gray friable clay, which should produce much better timber than it generally does. The timber is all well mixed, with about equal proportions of Banksian pine, spruce, balsam, tamarack and poplar, and a small quantity of birch. No really good timber was seen till the foot of Island portage was reached, where, on the right bank of the river, there is a small grove of perhaps twenty-five trees of spruce varying

Timber.

from nine to twenty inches at the base. From that point quite a number of fine trees were passed that would average fifteen inches. On one point of the river, about half a mile above the Mink portage is a grove of about twenty-five spruce trees averaging twenty inches in diameter. The water of the river is not only of a dark colour but also very muddy. This river is evidently very little used as a summer route, the portages being poorly marked and the bush, so far, unburnt. The best timber in the valley is up the three small rivers which empty near the lake.

'Above the Long Rapid some very fine sticks of spruce were noticed, one fully thirty inches in diameter. The land up to the Pelican portage is first-class, but above this there is a low and swampy country which extends to the "Rapids-close-together." A border of good land on which some fair sized timber grows runs along both sides of the river. The rock showing along this strip is all of a dark, or light-gray, massive gneiss. In one place only was it stratified, and even there it was difficult to distinguish the strike and dip. The Pelican River, though but a small stream, extends a long distance, coming from a little north of east. For the last ten miles before reaching the small lake, the river becomes somewhat wider and for the most part is lined with a border of reeds and rushes with a few stalks of rice. This lake, one of two through which the river passes, is a small one with a few islands. It is bordered nearly altogether by green wood which is here all Banksian pine averaging from four to six inches in diameter. The water is very dark and of a reddish tinge. The shores as far as seen are all of rock and small boulders of gneiss. No hills can be seen on either side. From here to the portage across to a branch of Poplar River, the stream is very crooked and its banks are thickly bordered with gray willow. They are very low and in years of even ordinarily high water they must be nearly submerged.

Good land
below Pelican
portage.

'The stream is here very shallow and in many places it is difficult to pass; especially is this the case at the sites of the old beaver dams, of which there are many.

'The country appears to be all swampy, for some distance at all events from the river. All the rock is dark- and light-gray massive gneiss.

'The portage from this branch to a branch of Poplar River, is divided about midway into two sections by a small lake. The first portage is 3,880 paces long, and although it crosses several narrow ridges of rock, most of it is through level muskeg, very much more than knee-deep in most places. The lake is called Watchee, or Greeting

Portage to
Poplar River.

Lake. The southern portion of the trail is by far the worst, as it is through a soft swamp, without any supporting moss.'

The rocks noted on the river are: at the first portage, gneiss, striking S. 60° W.; at Wolverine portage, coarse dark-gray gneiss, striking N. 30° E., and at rapids six miles above Pelican River, coarse, dark-gray gneiss striking N. 30° E., dipping S. 30° E. < 25°.

Poplar River.

Poplar River. From the portage, at the head of the north branch, downward, very little rock is seen, an exposure of dark-gray massive gneiss occurring six miles below the portage. The soil as seen along the river banks, which are about five feet high, is good, but it seems to form only a narrow border along the stream. Before joining the main stream the branch passes through a rougher, more rocky strip, and several falls and rapids occur. The timber on the upper part is heavier than down near the river, partly owing to better soil, but mainly to the absence of forest fires, the country near the river having been burnt over repeatedly. The first rock exposure below the north branch, is not of such a massive type as that up the branch; the strike is S. 10° E., dip N. 80° E. < 40°.

Thunder Lake. On an island in Thunder Lake, the rock is a very coarse, light- and dark-gray and brownish-gray hornblende-gneiss, striking east with a dip south < 20°. For fourteen miles farther down the river, there seems to be no marked change in the rock, which is probably all gneissic, with so little change in the strike that it has been noted in but few places. Contorted dark- and light-gray hornblendic and micaceous gneisses striking E., dipping N. < 55°, occur a mile farther down, and at the White Mud portage, ten miles above the Indian reserve is a very coarse, dark- and brownish-gray garnetiferous gneiss, striking N. 55° W., dipping N. 35° E. < 50°. The rock at the rapids two miles above the reserve, is a dark-gray gneiss containing mica and some small quartz grains, striking N. 65° W., dipping N. 35° E. < 50°.

Berens and Etomami Rivers.

Berens River. At the mouth of Berens River the rock is a reddish-gray thin foliated granitite-gneiss, and near Mr. McKay's house a gray contorted gneiss projects here and there in little rounded bosses, but apparently with a general strike S. 60° W. It is also cut by a vertical band of hard green gabbro-diorite two feet wide, with clear cut walls, striking N.W. The rock is well striated, except in places that have been exposed for

considerable time, and is covered with a dark-gray clay without pebbles. Along the contact line with the rock a boulder is, however, occasionally seen. This clay, like most of that seen on this shore, appears to have been deposited in water.

Similar granitite, sometimes massive and sometimes foliated, extends up the river to the mouth of the Etomami River and was found to underlie the country along that river throughout its whole length, to where it joins the Berens River at the Pot-hole portage. Mr. A. S. Cochrane in 1882 and Mr. A. P. Low in 1886* also found the country along the Berens River to be underlain by similar rocks between the same points.

At Pot-hole portage, just to the west of Long Lake, the portage road is across a low point of smooth rock. From a bay twenty yards wide, on the opposite side, a rocky point fourteen feet high projects north-eastward into the river descending more or less abruptly into deep water. On the south-west side of this hill and between thirty and forty yards from its point are several beautiful pot-holes. The uppermost one, with a rim ten feet above the water of the river, is filled with water and has only been cleaned out to a depth of about two feet. Three feet south-west of this one, are four others which have all cut into each other. The highest point on the rim of these is nine feet above the water, and the bottom of one is at least a foot below the water. The outer half of this one is cut away almost vertically and the face of the cut cliff is strongly scored by glacial grooves. Another one four feet farther south-west has the top of its rim, eight feet above the water, and descends to at least two feet below it. The diameter of this one is thirty-three inches and is almost perfectly circular at the top. It is quite vertical and unbroken, varying but little in width as it descends. Its rim is thus five feet and a half above the surface of Long Lake. Mr. Angus McKay, who cleaned it out, says that it was filled with rounded gravel and cobble-stones up to the size of a man's head. Several bushels of these are now lying about, mostly gray granite, but some are of greenstone. The rim is just on the edge of the steep rocky cliff descending to the water. Six feet south-west of it, is a well-marked, deep, smooth groove cut down the face of the little cliff, and at the foot, on a low terrace, are two other holes that have not been cleaned out. Near the deep holes, both above and below, are several small shallow holes also rounded out by pebbles and boulders.

The glacial grooves run generally S. 63° W. and the pot-holes are clearly older than this glaciation, for some of their rims show distinct

* Annual Report, Geol. Surv. Can., vol. II (N.S.), 1886, p. 17 r.

glacial markings on the southern side, while the opposite side is broken. The fracture that cuts one pot-hole almost vertically, is strongly marked by glacial groovings. They would appear to represent the position of a fall in a river flowing southward or south-westward in early glacial or pre-glacial times, the water tumbling over the ridge that here runs east for a short distance. Now, the ridge is cut away at most places, leaving this an almost isolated hill with lower land apparently all around it and certainly much lower to the north-east in the channel of the river. The rock here is a coarse, dark-gray massive, quartz-mica-diorite, containing some large irregular inclusions of dark-gray hornblende-schist. The diorite is irregularly fractured and jointed and it weathers with a very much pitted surface.

Painted-moose
portage.

Painted-moose portage, at the east end of Long Lake, is over a massive red granitite, cut by a dyke, about thirty feet wide, of coarse dark-green diabase, very much crushed and altered. The walls of the dyke are not well defined, but it has a general strike about east-and-west.

Manitou
portage.

Three miles higher up stream, the rock is a dark-gray diorite, cut by or associated with a mass of red granite. This diorite, outcrops at several places along the banks up to Manitou portage where the river flows between high, rounded rocks, of a massive, irregularly jointed, dark-gray quartz-diorite. The rock crossed by the portage is composed of a fine-grained groundmass of quartz, feldspar, hornblende, biotite, etc., in which are embedded large phenocrysts of plagioclase and quartz. It might thus be styled a quartz-diorite-porphyrite. Its relationships to the surrounding rocks were not determined.

Above this rapid to the Hudson's Bay Company's trading post at Grand Rapids, the rock is chiefly a red and gray granitite.

Crane
portage.

Crane portage is on the south side, over level clay, through poplar woods. The clay is a soft light-gray, without pebbles or boulders, and this is the highest point on the river at which it was observed.

Night Owl
portage.

Night Owl portage is through poplar woods over a rocky ridge. On the upper side of the ridge is sand with pebbles. On the lower side is a long slope of gray sand, apparently without pebbles. The total descent is almost forty feet. Boulders are plentiful above this to the Grand Rapids and the country is wooded with green poplar.

Etomami
River.

The Etomami River though a branch of Berens River, forms another channel in high-water, being connected at its upper end by a small creek which at low-water drains from a small lake to the Berens River below the Pot-hole portage. This creek is about forty feet wide up to

the lake, but it is almost choked up with wild rice and even on the lake, spears of it are seen here and there. Above the lake it gradually narrows until it barely permits the passage of a canoe, and then widens somewhat. It flows through a wide marsh between rocky hills and ridges wooded with tall Banksian pine, rising abruptly from the edge of the marsh. There is no sign of clay, but the whole country is rock and marsh and occasionally a tamarack swamp. The rock is a massive, gray gneiss, apparently similar to much that is seen in the Berens River valley. The first fall on the Etomami River, below the little lake at its head is about eight feet, but so little water is running that there is no fall in summer. The beavers have added to the natural barrier a little, in order to make the pond above useful to them.

For a couple of miles down, the river flows between steep, though not high, rocky hills of massive, gray granite, wooded with small Banksian pine, and below that, to near the Boulder Rapids, it winds between low-lying rocks in a spruce and tamarack swamp, with a weedy channel 60 to 100 feet wide. The only trace of later deposits over the rock, consists of light-gray fine-grained silt with pebbles, but this is very scanty. At the Boulder Rapids, which is a descent of fifteen feet in the river over boulders, the first stratified lacustrine deposits of the Lake Agassiz basin on this branch are met with. In a bay in the rocks on the north side is a large and well-defined terrace of coarse, reddish-gray sand, while just up the river in the gray silty till, are many well-rounded pebbles. The surrounding rocky hills are twenty to forty feet higher than this terrace. For a short distance below, the river flows in the bottom of a straight valley 200 to 400 feet wide and forty to eighty feet deep, with bold, steep granite sides. The channel is forty to sixty feet wide, with a bed of boulders, but is now almost choked with a thick growth of equisetum. It soon widens out, however, with low, sandy banks, wooded with tall, white poplar and Banksian pine, and farther down the whole country seems to a certain extent to be nearly a level plain of sand or clay, with rocky knolls and ridges projecting here and there.

Within ten miles of the mouth the banks gradually become better wooded with tall, white poplar, and Banksian pine in the more rocky places. A few stunted oak and maple trees also appear. Little or no spruce is seen near the river above this point, but a few trees appear. The river maintains an average width in the lower portion of over fifty feet, except at the rapids and a few narrows, but there is no current and very little water is flowing. The water is clear but exceedingly dark in colour. The banks are generally of clay, sloping westward,

with the slope of the country. The clay near the mouth is soft and blue, but farther up becomes gray and silty. The estimated fall for the river from Pot-hole portage on the Berens River to the mouth is over 180 feet,—it may probably be as much as 200 feet.

Pigeon River.

Pigeon River. On this river, from its mouth up to its head in Family Lake, the country is entirely underlain by granitite and granitite-gneiss, massive or more or less distinctly foliated, and varying slightly in different places from acid to basic varieties.

Sturgeon Falls.

At the first rapid, four miles and a half up the river, the rock is a mixed gray and reddish-gray, well foliated granitite-gneiss, striking S. 65° E., and with vertical dip. At the next rapid, between three and four miles farther up, it is a coarse-grained, gray, porphyritic hornblende-granitite-gneiss, with a well-marked structure striking eastward. Similar gneiss occurs at Sturgeon Falls, where it contains many darker lenticular inclusions, and has a general strike S. 65° E. Granitite-gneiss occurs all the way up the river, occasionally cut by granite veins, or containing darker inclusions, but varying so little in character that it is unnecessary to enumerate details for each separate locality, especially as the strike of the rock is shown on the accompanying map.

The general character of the country passed through is, however, added from the notes taken on the trip up.

From the mouth up to Sturgeon Falls, the river has wooded banks of clay but above this point to near the next fall, the stream winds with slight current, through low land with marsh occasionally on the edge of the river. The clay banks, however, gradually rise until they have attained a height of eleven feet at a point seven miles in direct line east of Sturgeon Falls. The rock crops out all along the bank, and the general thickness of the clay deposit is very much less than on the streams farther north.

Poplar Falls.

All the surface deposits recognized up to Poplar Falls are of clay, but there the banks are composed, from the water up, of a thickness of eight feet of horizontally stratified, fine, almost white sand, separated here and there by thin layers of white clay. The surface is unevenly eroded and is covered by two feet of clay and sandy soil, probably fluvatile. A short distance above, at a fall of nine feet, a great number of boulders are scattered on the beach at the foot of the fall. These are chiefly of gray gneiss and granite, but some of the smaller ones are

of massive greenstone. The banks are apparently of clay and have here risen to twelve feet above the water. The next rapid has a drop of four feet, past which is a portage of twenty yards over an island. The centre of the island is a level clay plain, nine feet above the water at the head of the portage. A number of boulders are embedded in the bottom of the clay, especially on the south side of the island. A third of a mile above the island portage, the river rushes through a narrow gorge in low hills of gneiss. At the south end of the rapid the clay rises in a terrace twelve feet above the water, but it is apparently well filled with pebbles and boulders; glacial grooves run S. 65° W., but on the south side on protected surfaces, a set trending S. 35° W. may be occasionally seen, probably only an earlier stage of the same glaciation.

On the west side of this rapid there is a portage-road one hundred and twenty yards long over the rock along the edge of the river.

The little lake through which the river passes a few miles above these rapids is called Round Lake and has rocky shores with occasional sandy beaches, and at the east side is a terrace of clay, six feet above the water. Round Lake.

At the Jack River portage, just east of the lake, the road is over a hill or bench of gray clay which is twelve feet above the water at the head of the rapid, and it is seen to be sandy with rounded and angular pebbles and some boulders. Three miles above, after passing two or three small rapids, the clay banks rise to ten feet above the water, but the general appearance of the country is an almost bare, rocky plateau, thirty to forty feet above the water. A fall divided by an island is next met, and with one above give a total descent of fourteen feet, equal to the depth of clay deposit below. The surrounding country has been burnt, and the smoothly rounded hills are streaked with a young growth of small Banksian pine, while over them the bleached trunks of the old trees are often still standing. The ascent of the upper part of the river is difficult, the current being often strong with many little rapids, and the steep rocks necessitate long portages often past very short rapids. Most of the portages are blocked by fallen timber. The clay does not appear to be a river deposit, but rather a thin coating of clay lying between the rocky knolls and sloping with the country. From here up to Goose Lake the river flows generally in a narrow valley, along the strike of the gneiss, and the whole country is rocky and barren. The current for the most part is strong and the fall from Goose Lake to below Long portage is estimated at about eighty-five feet. No timber of any value is to be seen on this part of the river. In the vicinity of Goose Lake the Jack River portage. Goose Lake.

country is almost all rock, but has not been burnt over and is wooded with tall, thin spruce and Banksian pine of no particular value. Above the last lake, there is a thin deposit of clay, perhaps two feet, in the hollows between the rocks.

The portages above Little Goose Lake are generally over rock, but along the north bank, at the middle one, is seen a scarped bank of twenty feet of sand, pebbles and boulders, doubtless on the lee side of a rocky hill. Boulders are scattered plentifully along the bank. Most of them are of the character of the surrounding rock, but a few are of white, rather fine-grained granite.

Shining Fall. At the Shining Fall or Little Grand Rapid the portage is 300 yards long, on the south side, over a plain of light-gray, clayey sand with pebbles, rising to the level of the top of the rapid and wooded with small spruce and poplar. The fall is a beautiful cascade with a drop of twenty feet, over a ledge of massive, gray gneiss, having a slight foliation S. 50° E.

Family Lake. Family Lake, which drains by this stream as well as by the Berens River, extends very far to the south of the arm from which the Berens River issues. The shores of this part are generally rather high and rocky. Those facing the east being smooth and scored or rounded by the glaciation, while those on the opposite side are broken and often the rock is hidden by a considerable thickness of sand and boulders. The timber is small Banksian pine and spruce with some birch and poplar.

Miskowow or Bloodvein River.

Miskowow River.

Near the mouth the rocks are very bare, but a mile or so up, the river has banks composed of clay about five feet high, wooded with poplar, some oak, &c., with low, rounded bosses of vertically jointed rock at the points. The stream averages from forty to fifty yards wide, with water of a brownish tinge, but not dark, like that in many of the streams on this side of the lake. The banks are never very high, but they are usually rocky and often the river would appear to flow in a pre-existing rocky channel. Between the rock exposures the blue clay that is seen everywhere in the lower land east of Lake Winnipeg, forms well-defined banks, wooded with poplar, while on the rocky parts is a scanty growth of Banksian pine. Oak grows here and there on some of the dryer points.

Pot-holes.

About nine miles from the mouth of the river a portage of 140 yards is made past a rapid and on the summit of this portage, at the very top

of the rock, fifteen feet above the water at the head of the rapid, is a beautifully rounded pot-hole eighteen inches in diameter and eighteen inches deep. A foot lower down the slope and ten feet south-east, are two similar holes, partially broken into one, respectively two and three feet deep. Six feet lower down on the southern slope are two more small ones. The rims of the upper ones are very perfect, but still they appear to be a little broken on their north-east and rounded on their south-western sides, indicating an age at all events previous to the last glaciation, perhaps interglacial.

The little Bloodvein River comes in at the north corner of a sharp bend above this and the river again makes another abrupt turn to the south-west. At this angle, which is a short distance below Birch portage, the river turns suddenly down through a narrow rocky gap, and a pot-hole was here observed on the south-east side of a steep rocky hill. It is quite round and has a diameter of thirty-four inches. Its top is ten feet below the top of the rock, and its rim is cut away obliquely so that the south-east side is two feet lower. Below this it has a depth of two feet. This lower part of the rim is now three feet above the present level of the river, but several feet below high-water level. The surface of the rock, sloping at an angle of 45° , is strongly glaciated. When formed.

From the Pot-hole portage up to the mouth of Turtle River the banks are generally rocky and there are many rapids, several having very picturesque falls. About half way in this distance the river divides and flows round an island half a mile long. On the north branch a portage of two hundred and twenty-five paces long is made past a fall of eleven feet. At the west end the road rises thirteen feet to the top of a little terrace of moderately well rounded gravel and the portage follows on a clay and boulder plain in a narrow gap between the rocks, falling, at the east end, two feet to a marsh. Near Turtle River. Terraces.

About two miles east of this, the terrace rises to twenty feet above the river and is of light-gray clay, but at the next portage a short distance farther, the surface is at thirteen feet, while above is a bank of nine feet. The bottom of this bank appears to be of bluish clay but the top is sand mixed with gravel, and on the surface it is a sandy plain lying between two ridges of rock.

The river here flows through a very rocky country that has been burnt over some years ago, and there is in this vicinity very little land of any value along its banks. This appears to be near the eastern limit of the Lake Agassiz clay. Eastern limit of lacustrine deposits.

In the vicinity of the forks the surface is a plain ten feet above the river, formed by a gray, silty clay with occasional angular pebbles and boulders.

North branch. The main branch of the river from the south-east enters a lake-like expansion, an irregular basin, surrounded by steep, though not high, rocky hills, thinly wooded with Banksian pine, small poplar and birch. In the depressions and on the lee sides of the rock is a thin coating of a rather loose, gray till containing a great many angular pebbles.

The north branch comes from Sasa-ginnigak Lake, but a short distance up it is divided into two branches, one coming from a narrow bay leading to the north end of the lake, the other by a shorter channel, from the south-west corner of the same lake. This to which the Indian name is given (instead of Island Lake) has rather high shores of granite, thinly wooded with Banksian pine and poplar. In it are many rather high islands which often stand close together. The water is moderately clear and without weeds.

General character of rocks. The underlying rock on the river, as far as it was examined, namely up to Sasa-ginnigak Lake, is everywhere a red, gray or greenish-gray granitite, either massive or foliated, the foliation often more or less nearly approaching the horizontal.

At the first portage, a mile above the mouth of Osapiniwina Creek, it is a medium-grained, reddish-gray, granitite rich in plagioclase, with occasional gneissic foliation. From there upward for several miles, the foliation is all more or less nearly horizontal.

Kinawi Rapid. At a portage, 140 yards long, where there are a number of pot-holes, the rock is a greenish-gray, basic granitite or quartz-mica-diorite. From this point upwards to Kinawi or Golden Eagle Rapid, a reddish-gray granitite is the prevalent rock, with a slight, nearly horizontal foliation, though at this place the foliation dips northward at an angle of 25°. From this rapid up to the forks, the rock, usually a gray granitite, is for the most part massive, and when foliation is to be detected, it is very indistinct. There is also a marked absence of pegmatite veins throughout the rock.

Similar granitite occurs up the main branch of Miskowow River to Kowtunigan Lake, above which this river was not examined. On the north branch, flowing from Sasa-ginnigak Lake, the rock at the falls above the mouth of Sturgeon Creek is an irregularly banded, red and gray gneiss, with vertical dip and east-and-west strike, having the general appearance of a mica-schist interfoliated with thin bands of granite.

Sasa-ginnigak Lake. On Sasa-ginnigak Lake, and on the two branches of the river below it, the rock is also a medium-grained gray granite, usually massive, but, occasionally foliated.

Shore of Lake Winnipeg—Dog Head to Loon Strait.

This strip of shore is very regular in outline and closely follows the direction of the strike of the gneisses. From the evidence of the exposures on the points and in Loon Bay, it is supposed that the channel, occupied in this part by the lake, is eroded along the line of a band of dark schist and greenstone which might possibly be of Huronian age, though much altered by contact with eruptive granite or gneiss—a band of which outcrops at Loon Strait. It is also supposed to continue, in a highly altered state much reduced in thickness, as far as the vicinity of Rice River where dark-green porphyry associated with porphyritic gneiss, and dark fine-grained schists outcrop above the first rapid.

General
character.

The larger islands off the point opposite Dog Head, are composed of a well foliated porphyritic granitite-gneiss, containing large porphyritic crystals of felspar, around which the groundmass exhibits a well marked flow-structure. The foliation is straight and regular in a direction N. 60° W., with a vertical dip. This evenly foliated gneiss gradually changes into the much less distinctly foliated gneiss seen on the shore to the east, no sharp line of demarcation between the two being evident.

East shore op-
posite Dog
Head.

On the point south-east of these islands the rock is changed to a coarse, porphyritic hornblende-granitite-gneiss, while at a point near the bottom of the bay south of this, there is a band thirty feet wide of a fine-grained reddish, porphyritic granitite-gneiss, behind which is a coarser banded, green and red hornblende-granitite-gneiss dipping north-eastward at an angle of 70°.

The next point down the shore, almost directly opposite Dog Head, is composed chiefly of porphyritic gneiss, in which are some darker and finer bands, as well as bands of fine red granite, all striking, as before, along the shore.

The next point, half a mile farther south, shows fifteen feet of an evenly laminated reddish felspathic granitite-gneiss, dipping N. 35° E. < 75°, cut by minute joints which cause it to break readily into small angular fragments, and weathering with a very red and much-pitted surface. Behind this, for 450 feet is a thickly laminated dark-gray hornblende-granitite-gneiss, weathering to a light rusty brown, and also breaking along numerous jointage planes. Succeeding this is a coarse porphyritic gneiss.

In-latitude 51° 43' 30", the rocks were examined for a mile and a quarter back from the lake, and were found to gradually lose their

strongly laminated character, until, at the end of the above distance, the foliation was marked by a slight linear arrangement only of the crystalline constituents.

About four miles south from Dog Head this shore is composed of a gray, foliated gneiss, striking N. 60° W. with an almost vertical dip. Some of the bands are dark and moderately fine-grained with veins or bands of fine, red granite, striking in the same direction, lying along the plane of foliation. The composition of the gneiss which might be termed hornblende-granitite-gneiss, is found to remain very uniform for some distance, but gradually loses its crystalline appearance, becoming, farther south, more micaceous, and in places is in part a mica-schist. The foliation throughout is very even and regular with few contortions.

Opposite
Limestone
Cave Point.

Abreast of Limestone Cave Point, the shore-line crosses the strike for a short distance to the west. Opposite some small islands lying near the east shore, the rock is a reddish-gray, thinly foliated gneiss, but the foliation is not so regular as before, and many of the bands anastomose with each other, so that it is difficult to determine the exact strike. It is, however, nearly parallel to the general trend of the shore-line.

Surface de-
posits.

The rock is overlain by a foot or two of coarse, angular sand containing pebbles and boulders, few or none of which show any sign of glaciation, though the rock is smoothed and grooved. This sand is in turn overlain by a soft blue clay without pebbles, the same as noted before. On the surface are some pebbles and boulders. The whole shore is here piled up often to a height of ten or twelve feet, with large, rounded and angular boulders, many of which are of massive gray gneiss. To the south the shore for a short distance is sheltered by long narrow islands, and boulders are not so plentiful. Passing these, the shore becomes high and rocky, cut by deep, narrow inlets. The rock is of similar character, with a strike parallel to the shore. Little cliffs of clay and boulders are seen farther on, overlying the rock and the shore is strewn with boulders chiefly of gray massive granitite-gneiss. These little boulder hills extend along the shore for a considerable distance and appear to be morainic. The islands mentioned above are mainly rocky, though covered by spruce and scrub pine. The rock is a rather fine-grained regularly-foliated granitite-gneiss, with a few veins of red pegmatite running generally with the foliation, but at times crossing it obliquely. On the mainland a little to the south, the gneisses are tinged with a light-green colour, becoming deeper across the strike to the east. At about one

hundred yards east, bands of green chlorite-schist appear, interbedded with the granitite-gneiss, while farther on there is a dyke or band of green chlorite-schist with a width of nearly five feet. In it are seen large included crystals of orthoclase. This band is parallel to the foliation, but in one place it appeared to differ in dip, apparently going under the gneiss to the north, which is normal in character, while that to the south is altered to a hard, flinty, sheared quartz-porphry. Between the dyke and the altered rock are many small quartz veins. The greenish colour is imparted also to the gneiss on the outer islands, and no doubt indicates the near presence of a contact with the greenish eruptive rocks of the Huronian, which probably occupy the bed of the channel of the lake to the west.

Opposite Bull Head and a little to the north, the banded green and reddish gneisses are again seen. At a small cove bearing N. 10° E. from Bull Head the rock is the typical banded granitite-gneiss very much broken by a heavy irregular green band running along the line of the strike. Through this are also many little bands and lenticules of red rock, which in many places have numerous angular cavities and in other places are made up largely of rock fragments. With these are also many irregular bands and strings of white crystalline calcite. A small creek near this empties into a cove, in the mouth of which is an island. This is too small to be shown on the map, but its position is directly east from Limestone Cave Point. At half a mile from the mouth the creek forks into two equal branches where the rock exposed is a reddish-gray gneiss, distinctly and evenly foliated, with a persistent strike north-west, and practically vertical or inclining slightly to the north-east. This gneiss is similar throughout, except for a few veins of milky quartz and red granite following the strike of the beds. Similar gneiss is seen on the lake-shore, and just south, at about half a mile, the great part of the exposed rock is a similar thinly-laminated gneiss, but on the extreme end of the point is a greenish-gray eruptive rock with which is a red band that weathers into a conglomerate-like mass, the larger crystals standing out from the decomposed ground-mass. This band is also well shown at the point near the stream, occupying a yellow sided trench. One hundred yards south the dyke appears to consist of a gabbro with chlorite, felspar, &c. Thinly laminated red and green schists strike along the shore to the south, inclining at a high angle towards the north-east, and in places the shoreline is in the form of a steep wall twenty to forty feet high. A great similarity in the exposures is noticed along this stretch, as the same beds practically occupy the shore to Loon Creek. Six miles north of the mouth of this stream the rock is a granitite-gneiss. It is inter-

Opposite
Bull Head.

East of
Limestone
Cave Point.

bedded with dark-green amphibolite bands and is cut by wide veins of granite. In many places it is much broken by small irregular faults, in the lines of which are veins of light-green epidote. The rock is probably more broken than any yet seen. It has a strike N. 40° W., and on the inside of the bay there is a light dip N. 35° E., but on the point the dip is to the south-west.

Loon Creek.

Loon Creek.

Loon Creek was examined for six miles from its mouth. At the first rapid, two miles up it runs through two cracks in the rock, the larger one of which is about three feet wide. Below this the river is from one hundred to two hundred feet wide, but without current, and its banks are three to six feet high, composed of light-gray, alluvial clay, without boulders. Here and there a boss of gray gneiss crops out from beneath the clay. The banks are wooded with poplar and spruce up to twelve or fourteen inches in diameter. The rock at the rapid is a massive, gray granite or gneiss, with a very slight foliation N. 38° W., but does not at all partake of the character of the foliated gneiss hitherto described on the east side of the lake. The next rapid is a short distance above, and very similar to the first in character. The river above makes a long turn, first to the west and then north, and around to the south-east to a point a mile and a half north-east of the second rapid. In this distance two rapids are passed within a mile, and gneiss, similar to that on the lake, is again met with, running N. 57° W., and generally nearly vertical. At the most northerly point on the bend in the river, it expands into a little lake, one hundred yards across, on the east side of which there is a rapid over rock and boulders. To the north is a portage through woods for seventy-five yards. The rock is smooth and well glaciated in a direction S. 55° W. It is a similar reddish gneiss well foliated in a direction N. 58° W. Blue clay is present all along over the lower parts of the

Fourth rapid.

At the last rapid, the fourth from the lake, the portage is over smooth rock of similar gneiss. From this smooth rock portage the river widens and runs between low wooded banks, covered with large spruce and pine. A short distance above the big bend the creek is divided, and is reported as coming from an extensive tamarack swamp. The upper reaches still show the underlying rock to be a banded gneiss, striking parallel to the lake-shore, but cut by many pegmatite veins running in all directions.

Shore of Lake Winnipeg—Loon Creek to Wannipegow or Hole River.

The shore-line from Loon Creek southward is not so regular in outline as toward the north. This is caused no doubt by the fact that the band of schist and greenstone which occupies the channel south from Dog Head, is not so deeply eroded beyond this point. A ridge of granitic-gneiss appears on Loon Island and along the shore south from Loon Strait. On the eastern side of this island and on the western side of Loon Bay the granite holds inclusions of the schists of the above mentioned band.

General character.

On the western side of the island and along the shore for some distance the gneissic rocks are the only ones seen, but on some small rocky islands near the shore, east from Berry Island, inclusions of mica-schist are again noticed. These are probably fragments from Huronian rocks which outcrop on the islands of the Pipestone Island group and also on those farther south.

The line of this outcrop follows and gradually approaches the mainland and east of Pipestone Island, passes between the outlying islands and the shore. From Black Island to Hole Bay the mainland is of gneiss but apparently all the outlying islands are of Huronian rock.

The mouth of Loon Creek is filled with wild rice and blocked by a number of rocky shoals. The bottom of Loon Bay, west of the river, is low with a clay beach. The west side of the bay consists of low rounded rocks. On a point across from the river the rock was found to be a well-foliated light greenish-gray gneiss or amphibolite-schist with a strike N. 40° W., and dip S. 40° W. < 70°. In places the foliation is undulating, or affected by small abrupt twists. Running more or less with the strike are many bands of red granite and beside them are often little strings and pockets of epidote. Immediately back of the point it is found that the schist is followed by a massive greenish-gray granitite, with the crystals somewhat drawn out in a direction N. 30° W. It is cut by a few little strings of granite. Northward the schists are found to touch again on the point and also on the island beyond. The schist seen near the north-east end of the point is similar to that described above, but is there striking N. 53° W., and the point is cut across by a vein of red granite eight feet wide. Many little faults cut the schist in all directions, and along the lines of the faults are strings of light-green epidote. Many strings and lenticules of quartz are found between the beds. A short distance farther west, in the bottom of a little bay, the schist and the gray granite are clearly seen in unconformable contact. The schist dips

Loon Bay.

Unconformable contact.

under the granite, but the granite cuts it quite irregularly, cutting across the schist first at an angle of 10° to the foliation and then sending off a vein three feet wide into the schist at a much wider angle. Close to the line of junction the granite also includes many irregular, generally elongated, fragments of the schist. Small pockets of tourmaline crystals were observed in the schists not far from the contact.

Approaching Loon Strait, a small island, lying a quarter of a mile south-east, is found to be of similar green schist, cut by veins of red pegmatite running with the strike of the beds.

Contact of
schists and
gneiss.

On Loon Island the contact between the schists and gneiss is found to occur on two points on the east side. At the most northerly of the two the contact is clearly seen, and is much broken, the gneiss sending out long arms into the schist at a small angle to the general direction of the line of contact.

Loon Island.

At the middle point of the south side of the island, are several inclusions of hardened schist in the gneiss. The largest one runs out at both ends into the water, and one hundred feet of it is seen. Its width is twenty feet, and ten feet of gneiss is seen beyond it. On the east side a long arm of the gneiss runs into it. The border of the gneiss is fine-grained, for about six inches from the schist. The edge of the gneiss is practically vertical, but the schist dips south-west at an angle of from 60° to 70° . In places the foliation of the schists is twisted. In one especially, it bends round the edge of the gneiss, but generally it is cut off irregularly.

The west side of the island consists of low rock, rising from one to four feet above the water. It is a dark reddish-gray, massive granite-gneiss, cut by a few veins of coarse red granite. It also contains, as noted above, many large and small angular inclusions of dark-gray, laminated gneiss and schist. Small rocks in the bay to the south, are found to be generally massive gneiss, with the exception of one near the strait, which is of schist, probably one of the large inclusions noted above. The bay to the south is a long narrow inlet flanked on both sides with rock. That on the east side is generally low and slopes gradually into the water, while on the west it is more abrupt. The former contains inclusions of dark mica-schist, and is cut by veins of quartz and tourmaline. The latter is very uniform. All the gneiss is precisely similar to that on Loon Island, and has a general strike $N. 58^{\circ} W.$ The bay terminates to the south in an extensive marsh. It is possible, that there may be

water communication from this long bay out to the west, as the shore there is low and marshy. The points alone are rocky, with little rocky islands lying off them. A similar gneiss is found farther south along the mainland. The first exposure on the extreme western point is of a well-foliated gneiss, with alternating bands of gneiss and mica-schist. The foliation is generally much contorted, with a general strike of about S. 78° W.

A long low strip of shore is next passed in which the points and out-lying shoals are composed of a reddish-gray granite-gneiss often broken by masses of red granite. The contortion in the beds appears to have affected the general strike of the rocks for a short distance. The end of the point terminating this fairly straight piece of shore-line shows a light green-gray gneiss, through which run bands of dark-gray mica-schist. The gneiss is very irregularly folded and crumpled, but the general strike appears to be about S. 78° W. and the dip S. 12° E. at an angle of from 30° to 48°. The gneiss is moderately fine-grained and like that at the last exposure contains a considerable amount of plagioclase, probably also with some orthoclase. Included in the bands of gneiss are some bands or lenses of hornblende-biotite-gneiss much like the gneiss farther south. On several points south of the small indents in the shore-line lying about north-east from Berry Island, the gneiss is found to be still much contorted, but the general strike is nearly parallel to the shore. Small veins of mica-schist cut across the foliation with occasional veins of red granite.

A low string of islands lying very near the shore and situated directly east from Berry Island, are composed of coarse biotite-gneiss showing very little foliation, but with several inclusions of dark compact mica-schist lying about N. 58° W. Some of these are lenticular with long tapering ends, and others are drawn out into beaded strings. Veins of dark-red granite also run in the same direction. These veins were especially observed on an island at the southern end of the group. Separated from the string of islands noted above and nearer the shore to the south, a small island is found to be composed of a greenish-gray quartz-diorite, quite massive, showing no sign of stratification or foliation. This is very much checkered by little cracks along which run strings of black hornblende or tourmaline with which are often lenses of quartz. It also occasionally contains large and small inclusions of pyrites. This island is about fifty yards from the shore, and the point opposite is composed of a dark-gray quartz-mica-diorite, showing a crystalline foliation in a direction N. 80° W. Into this gneiss, from the direction of the island, a mass or tongue, twelve feet wide, of fine-

East of Pipe-
stone Island.

grained amphibolite extends. The points south, to abreast of Pipestone Island show exposures of hornblendic gneiss, cut in many places by fine veins of granite. At one point, a band of massive, dark hornblende rock, abuts against the gneiss and strings of gneiss run out through it in many places, while many pieces of the amphibolite are included in the gneiss, often having the appearance of a true conglomerate. The small islands off this part of the shore show dark hornblendic rock, and the junction as seen above on the point, is no doubt that of an eruptive contact.

The group of islands extending along the shore, south from Pipestone Island are generally of the green schists and altered eruptives of the Huronian, but near the shore-line and on the mainland, the rock is a porphyritic gneiss. The contact line is apparently not seen, being no doubt under water.

Mouth of
Rice River.

The bay into which Rice River enters, is denuded across ridges of this gneiss, leaving many islands as interrupted ridges running with the strike. The immediate basin in which the stream falls, is a long narrow bay with two entrances, nearly closed by a long island lying in front. The shore is here steep, rising to thirty feet above the water. It is composed of a crushed granite, similar to that farther north along the mainland. Some of it is massive, while much is schistose. The strike of the rock here is N. 33° W., the dip S.W. at an angle of 60°. A quarter of a mile to the east it is finer grained and has a distinct foliation. The strike is N. 23° W. and stands vertical. It contains several bands of fine-grained reddish granite along the lines of bedding; also interbedded with the lighter schist are some thin bands, of dark-green schist, with one lenticular band, having much the character of a coarse agglomerate or breccia. On the south side of the arm or bay, the rock is generally the same as on the west side, but it also varies, and dark and light schist is found in moderately thin bands.

Rice River.

On Rice River the section is across the strike, and gives a succession of dark porphyritic gneisses and some eruptives, followed farther inland by lighter coloured granites and gneisses. The river follows an irregular course, owing to the ridges of rock running across its general direction of flow. Near its mouth, at the first rapid, the beds are a gray gneiss, followed by fine grained dark beds, and at the head of the rapid an eruptive dark-green porphyry, in which large crystals of felspar are abundant. Half a mile across the strike the next exposure is of a gray granite-gneiss, with irregular or very indistinct foliation. The next exposure is about three-quarters of a mile across the strike, and is of a red gneiss evenly banded, which

again cuts across the river farther up. The gap in the section between this red gneiss and that at the first rapid, is probably occupied by altered eruptives, which probably are stringers of the dark band of rock, which forms the trough occupied by Loon Bay to the north. The dark gneisses and schists of Loon Bay are last seen striking southward, and the eruptive contact with the granite of Loon Strait would suggest that parts of the same band might be found to the southward of this granite. On Rice Lake the exposures are of a reddish-gray gneiss, followed to the east by gray granitite-gneiss, more massive, but with a slight foliation. The river averages about fifty feet in width, but is in many places obstructed by boulders, and in others very shallow and full of rice. The country is mostly rocky, with alluvial patches here and there. Rice Lake is very irregular in shape, and generally shallow, many of the arms being covered by a thick growth of rice. The shores are in places low and wooded. Above the lake the stream is sluggish for a couple of miles and the banks low and marshy, the country rising very gently. Knobs of gneiss bearing Banksian pine rise on every side, with intervening areas of muskeg covered with grass, bushes and small tamarack. The rock is a similar granitite-gneiss, foliated N. 48° W., with the surface showing glacial striae bearing S. 60° W. In the upper stretches the river narrows considerably, and falls in several small rapids. The strike of the gneiss swings around to the north-east, the last observed being N. 55° E., and the dip S. 35° E. at a high angle. Rice Lake.

The shore, to opposite Black Island, is composed of similar gneiss ridges, generally high, dipping steeply into the water, cut by deep bays running in transverse to the shore, and approximately parallel to the direction of striation. It is wooded with aspen and a few spruce and scrub pine. Opposite
Black Island.

The islands between Black Island and the mainland to the east are all of Huronian schist and greenstones, and the probable line of contact between the gneisses and granitites of the east shore and the Huronian rocks of the islands, follows very closely along parallel to that shore. The gneisses strike about parallel to the shore-line, and practically the same beds are followed south to the end of the bay near the mouth of Hole River. On a point almost opposite the north end of Black Island, the rock is a well-foliated gneiss, striking N. 22° W., and dipping S. 68° W. < 65°. In one place it is cut by a thin band of granite. On the south-west it is interbanded with green porphyritic gneiss and on the north-east it lies against green, foliated, porphyritic gneiss. In many places the contact appears to be conformable, but in East shore
south of Black
Island.

Porphyry.

others it is cut or gradually replaced by the green porphyry. This porphyry is seen again farther south, about opposite the east end of Black Island. It is a much altered and squeezed rock composed of quartz, felspar, biotite, chlorite and magnetite. The quartz is granulated and the felspar occurs in rather large individuals and very much kaolinized. The biotite is in minute scales largely altered to chlorite and scattered through the section. Calcite and epidote also occur. Altogether the rock has the appearance of a much crushed and altered granitic material and being very near the contact with the schists of the Huronian, it seems impossible to determine whether this may not be a much altered lower member of that series. At the south-east corner of the bay, just east of Hole River, the contact of the gneisses with the dark-green schists is very sharply defined. The schist has the appearance of a boulder conglomerate, the boulders lying in the line of strike with the schist drawn around them in thin bands. A great number of white veins of quartz are scattered through the schist in an irregular manner. From this contact the Huronian rocks are found skirting the shore to Clement Point.

Contact with
Huronian.

Pipestone Island Group.

Pipestone
Island group.

The group consists of one island with a few trees growing on it, and a cluster of bare rocks extending in irregular order to the mainland to the south-east. The outermost rock lies about a mile north-westward from Pipestone Island in line with Berry Island. It is narrow, bare and about fifteen feet high, composed entirely of a massive dark-green, partly decomposed, eruptive. In one place it is crossed by a little band of green schist and dolomite. Green porphyritic gneiss is seen on the next island to the south. It is cut by masses of dark-green trap, probably dykes from a large mass to the south-west.

Pipestone
Island.

Pipestone Island is small and partly wooded. At the north-west end are abrupt cliffs fifteen feet high, while at the south-east end the shore slopes to near water-level. The middle of the island is about twenty-five feet high. The north-west side is composed of bluish, moderately thin-bedded serpentine, through which run a number of veins of fibrous serpentine mixed with magnetic iron-oxide. Some of the veins are almost entirely metallic. The east side is composed of a light grayish-green serpentine, some of which is calcareous; that which appears to compose the greater part of the island is much mottled with red. Through it are some veins of calcite and dolomite, or barite.

On a small island to the north is a light-green, porphyritic gneiss dipping vertically and striking towards the north end of Berry Island. On the east side a narrow dyke three feet wide runs first with the strike of the gneiss, and then curves gently round to the north, crossing the strike and widening somewhat in places. In this cross portion many little strings run out from it into the gneiss, and in one place an elongated fragment was clearly seen in the dyke. The rock especially in the straight portion is quite schistose. From the north side of this island the dyke appears to cross to another island.

Half a mile south-east of Pipestone Island a small island one hundred yards long, consists of light-green porphyritic schist dipping vertically and striking north-east. It is cut by a vein of fine granite four feet wide running parallel to the strike. This island appears to be to the east of the line of contact between the gneisses and the green eruptives of the Huronian belt, but the next island south, an isolated rock about two miles south from Pipestone Island is composed of rotten, green rock, very irregularly jointed and fissured, which is probably Huronian. It is generally quite massive but on the south-west side it shows in some places a schistosity striking towards Berry Island. The rock, especially on this latter side, is altered to serpentine and along many of the fissure lines, oxide of iron has been separated out. The islands to the east of this are all of porphyritic gneiss similar to that of the mainland.

Islands in the Punk Island Channel.

The islands along the east side are mainly of the fine schistose gneiss, light-greenish in colour, striking along the shore. They are very numerous and rise out of moderately deep water and are generally wooded with poplar or Banksian pine. Behind, the shore is broken by inlets and marshes and the scenery in this vicinity is very picturesque. Toward Punk Island numerous small rocks appear but little elevated above the water and nearly all are of the dark-green eruptive similar to that on the islands immediately north near Pipestone Island. The outermost ones are distributed nearly along the centre of the channel. The southern one is of green chlorite-schist, and the one next to it to the north is composed at its eastern end of a comparatively coarse, light-green diabase in which many porphyritic crystals are clearly seen. This is striking west, and dipping south at an angle of 80°. It is evenly but not very distinctly bedded, and about seventy feet of beds is exposed. South of this, is one hundred feet of similar rock, but finer-grained, cut by thin anastomosing bands of chlorite-schist into oval masses three to six feet in length. This character is very strongly

Dykes on small islands.

Islands east of Punk Island.

marked and many irregular masses and ramifying veins of quartz are also present. South of this again thin bedded chloritic schists occupy the point of the island. Massive light-green diabase with a slight tendency to schistosity is shown on the next pair of islands to the north, the rock still striking westward. The most northerly of this lot, in the centre of the channel, is opposite the south corner of the east end of Punk Island and is of light-green, gray-weathering, rather coarse-grained rock, apparently almost massive but occasionally showing a slight foliation N. 60° W.

Islands near
Punk Island.

Referring to the islands nearer Punk Island, a similar string runs south-eastward from near the south-east corner. On the first or northernmost group is seen amphibolite which weathers into a soft light-brown mottled schist. In places it shows very perfectly the ovoid structure remarked on one of the islands in the channel to the eastward. Coarsely granular, green schist crosses the next small island striking about N. 70° W., and dipping at a high angle south.

The rocks on the next three islands lying across the strike are all fine- and coarse-grained diorite, in some places showing a slight schistosity. Two islands lying farther to the south are both of dark-green, coarsely crystalline amphibolite.

Black Island—north shore and outlying islands.

Rocks of
north-east
shore Black
Island.

The western part of the island is overlain by sandstones and limestones elsewhere described as of Black River, and Trenton age, but along the shores of the eastern part, both north and south, dark-green schists and greenstones of Huronian age outcrop along the beach. The exposures on the north side are found to extend westward for about three miles and are mainly of dark-green eruptive rock. Bands of schists and slates probably of sedimentary formation, occur at the extreme eastern end and also on the point on the north shore of the island south of the largest outlier, but there is a greater variety of these rocks exposed on some of the islands just to the north. The rock at the extreme north-eastern corner, is a soft, silvery-white, sericitic mica-schist. This is followed at a short distance by a soft chloritic schist striking N. 10° W., dipping S. 80° W. < 70°. In it some heavy veins of white quartz are included and with this are some streaks apparently of hæmatite.

For three hundred paces west along the shore, similar schist is seen, much of it glistening white on the surface. Scattered over it are many fragments of quartz. A short distance is then found covered

with sand, and the next exposure appears in rounded glaciated bosses of a more crystalline character, apparently an altered eruptive, although portions show a diabasic structure. The rock is mainly of chlorite, and extends to the first point where it shows a more porphyritic appearance. The islands opposite this bay show practically the same rocks, which vary from chloritic and sericitic schists to hornblende-schists, but farther westward darker schists are seen on the points lying just to the east of the small peninsula which here projects to the north-westward. On the eastern part of this peninsula the rocks are a tough blue felsite with a slaty cleavage striking N. 35° W., and dipping at a high angle south-westward. The shore along the outer or north-eastern part is generally high and about half of it, the eastern part, is composed of the felsite just mentioned, while the western part to the extreme end of the point, is occupied by an essentially massive dark-green or blue coarse-grained rock. On the north-western end it contains a number of angular fragments of the light-blue slate. A large number of islands lie to the north-east of this point, and on many of them, green schists are found striking in a westerly direction. On one of the large outer ones thirty feet high, green, epidotic, clastic schists are seen and on the neighbouring islands this is succeeded both on the north and south by massive coarse-grained eruptive bands. The schists of the inner islands are probably continuous with those that are noted toward the eastern end of Black Island.

Small peninsula.

From the end of the peninsula, westward for nearly a mile, the outcrops are of the coarse, dark eruptive, but a band of green agglomerate striking S. 70° W., appears on the outer part of the point. It is apparently only a few yards in thickness, and is followed a short distance in the bay to the west by a green rock showing a peculiar structure. It is composed of oval masses from three inches to two feet in length of similar green rock, and around these and cementing them together run thin bands of green schist. At the angles in these bands there is often developed a little mass of hematite.

Of the outlying islands it is a little difficult to place the descriptions, as the group is irregular, but the larger ones and many of the rocks appear to be made up of massive greenstones and schists which are squeezed eruptives. The most interesting exposures are on several small islands in the centre of the channel, between the end of the peninsula and the largest island to the north-west. The section from south to north across the strike shows the beds in the following order :—

Islands north of Black Island

At the south end of a small island, green mottled rock of a massive type gives place to thin-bedded light-blue slate. This is interbedded with a green agglomerate in which the pebbles are at first few and small. They, however, soon become larger and more numerous, and the rock assumes a slaty character or rather is cut by a slaty cleavage striking S. 80° W., while the strike of the rock itself is due west. Farther north the agglomerate is nearly massive, and finally, at the end of the island contains pebbles three to five inches in diameter. Two small rocky islands farther on are of massive green rock and across a small gap the section is continued on another island. This is composed of agglomerate-schist on the south side, running into a thin-bedded chlorite-schist, while on the north side it is somewhat harder, and strikes west, standing vertical. This latter rock shows a slaty cleavage differing in direction from the strike.

Ferruginous
boulder-clay of
Black Island.

The remainder of the north shore of Black Island shows exposures mainly of drift-deposits and the soft sandstones at the base of the Trenton, but about midway along the shore a sandy till is found hardened by iron-oxide, and the shore is completely covered by dark-red slabs for four hundred yards along the beach. This ore is, no doubt, derived from the presence of iron oxides in the underlying rocks, which have been absorbed by the sandy bed lying immediately above, as a somewhat similar though less intense staining was observed on the sandy beds of the east end of Punk Island.

Black Island—south shore.

Drumming
Point south-
ward.

Drumming Point is an old Indian camping place and burial ground. The rock exposed at the shore is a well-bedded, wavy, green and reddish schist striking N. 25° W., and dipping south at a high angle. This is overlain by light-brown sand, which rises in an easy, grassy slope to a height of forty feet above the lake. The top is wooded with small Banksian pine. The shore runs to the south for a mile, and along it green schists are seen of the same wavy character, sometimes somewhat massive. Behind the point a deep bay runs to the north, from the end of which a road has been cut back into the bush. Following this for a short distance it ascends to a height of fifty feet above the lake, to the top of a sand ridge, probably a beach dune. Beyond this the country falls a little to a forest of spruce and pine. Near the shore some larch is growing, with spruce, balsam and poplar.

Islands to the
east.

The islands in the channel between this part of Black Island and the mainland show the same green wavy schist as at Drumming Point,

but veins of quartz are noted on many of them. Those nearer Black Island, and near the mouth of the deep bay noted above, show green, chloritic schist running generally north-west, but on the island at the mouth of the bay this schist merges into a massive, green, granular trap on the west side of the island.

The shore, from this deep bay south-west to the large island lying close alongside Black Island is quite irregular, and several small islands lie off it in a north-and-south line from the deep bay. These are of light-green schist, and on the most southerly one is seen dark-green trap, in places distinctly foliated and striking N. 28° W., dipping S. W. < 65°. The foliated bands contain bands of ferruginous schist and a considerable amount of vein quartz. The rock is well striated and overlain by a white till with boulders. The north point of the large island shows a green, well-bedded schist, striking N. 25° W. It includes small lenticules of quartz and lenticular beds of dolomite.

Along the irregular shore opposite these islands, green schists and massive traps are exposed. The beach of the southern part is generally sandy, but along the northern, numerous boulders are piled on the shore, having fallen from the banks of soft blue clay behind. From the bottom of the bay, about midway along the sandy strip, a good foot-path is found, running back into the island to a favourite blueberry patch, to which the Indians resort during the berry season. Following this path north-westward for nearly a quarter of a mile, the ground is found to be all sand, and to rise gradually to a height of ninety feet above the lake. No boulders are seen, and the land is evidently immediately underlain by Palæozoic sandstone. A belt of spruce runs along the lake, growing on the alluvial clay, and the sand above is wooded with small spruce and pine. A terrace runs along at forty-five feet above the lake, which has every appearance of being an old shore-line. Above this, pine is growing, and below it, spruce and poplar.

East end of
Black Island.

Adjacent
islands.

Terrace, forty-
five feet above
lake.

The large island to the south appears to have few exposures of the underlying rock along its western side. On the north point, as mentioned above, are green schists. Along the inside shore, which is thickly strewn with boulders, mostly of gneiss, runs a little cliff of light-gray, sandy till, holding many pebbles and boulders. This is evidently a deposit of till, dumped behind the ridge of rock that forms the body of the island. At the end of the boulders and near the west point is an outcrop of mottled green, generally massive trap, showing oval structure in many places. Through it also run many schistose bands striking N. 40° W. It contains a considerable amount of pyrite.

The surface is well striated and over the sandy till is a band of four feet of light-gray stratified clay, evidently that which is commonly seen around the lake. The shore southward to the end of the island is largely strewn with boulders throughout, and is often backed by a little cliff of till with pebbles. The massive, green rock gradually gives out and is replaced by a light-coloured schist, striking along the shore.

South side of
Black Island.

The exposures of Archæan rock on the shore of Black Island west of this, are all within a distance of a mile, with the exception of that at the centre of the island—the iron-ore deposit. On the first point west from the island just described is a hard gneiss rock, mostly massive but occasionally schistose. It contains arsenical pyrites, and in places shows the oval structure seen in the rocks of the north side of the island. It is cut by a few moderately wide veins of rather fine-grained red granite. A short distance west of this, the rocks are of soft, light green massive rock, associated with a hard, green schist, and nodules of quartz pyrite, hematite, &c. Some of the schists are quite silvery and strike generally to the west. Several shanties stand here, a small wharf is built at the next point, and a hole has been put down to a deposit of iron-ore, but apparently work has been abandoned.

The next exposure westward is of a green agglomerate, very compact and striking north-west. This is followed by a small outcrop of massive, green augite-porphyrite. From here westward the shore is generally formed from the sand or boulder-clay deposits which cover the main part of the island.

The deposit of iron-ore on this island has been described by Mr. J. B. Tyrrell in the Summary Report for 1889, and this description is here reproduced in connection with the general account of the rocks of the Huronian band of which it forms a part :—*

Iron-ore on
south side of
Black Island.

‘Five miles and a half along the south-east shore from its south-west point, altered and highly inclined rocks are for the first time met with. They consist of light-green sericitic schists and quartzites probably of Huronian age, which are often externally reddened by oxide of iron. When first met with they strike N. 15° E. and S. 15° W., and dip at angles varying from 60° to 75°. These schists outcrop along the shore for a distance of 450 paces, forming generally a rough, irregular beach which slopes gradually into the water.

‘Towards the north-east end of the exposure, however, a low rugged cliff rises above and behind the sloping beach, and on examination this cliff is found to consist in the centre of a mass of hæmatite, which

* Annual Report, Geol. Surv. Can., vol. IV (N.S.) 1889, pp. 16-18 A.

extends along the shore for a distance of a hundred paces and rises to the height of seven feet above the water. As shown in sections running back from the shore, it dips away from the lake at an angle of 30° , and in the vicinity of the mass of ore the bedding of the schist is almost entirely obliterated.

‘The ore is a more or less pure hæmatite, not very compact on any of the exposed surfaces, and with numerous little seams and particles of crystalline calcite scattered throughout the mass, along with which are also a number of small lenticules and crystals of quartz. In some places, especially near the outside of the mass the hæmatite assumes quite a pisolitic or botryoidal structure, the spherules being often arranged in very well-defined rows, the interspaces of which are filled with calcite.

‘Towards the outside of the mass in places the ore has been converted for from a few inches to a foot, into a hydrated oxide of iron or limonite.

‘No analyses have yet been made of the typical specimens collected during the past summer, but a number of analyses have been made of specimens previously sent in from Black Island, both in the laboratory of the Geological Survey of Canada and by Messrs. Gilchrist, Riley and Miller,* in London, England.

‘These show an amount of metallic iron, ranging from 53.99 per cent downwards. None were found to contain more than a trace of phosphorus. One specimen gave on analysis 2.026 per cent of sulphur, the sulphur being present in the ore as finely disseminated iron-pyrites, while three other specimens show respectively 0.07, 0.12 and 0.032 per cent of this impurity. In the other five analyses the sulphur was not determined. No iron-pyrites was seen in the general run of the ore, but indications of decayed nodules could be traced in a very few places as yellow incrustations on the surface of the rock, and two or three small nodules were seen lying loose at the bottom of the cliff.

‘As stated above, the deposit extends for about 300 feet along the shore, which has here a direction of N. 70° E, rises to a height of seven feet in the centre of the exposure, and dips back from the shore at an angle of 30° . The direction of its strike differs very materially from that obtained for the schists at the south-west end of the exposure, but in the immediate vicinity of the ore itself the bedding was entirely or almost obliterated, so that it was impossible to determine in the short time at my disposal, whether it was a true bedded deposit or a lenticular inclusion in the schists.

* Journal of the Iron and Steel Institute, No. 2, 1886, pp. 547-615.

Schists associated with iron ore.

'The hæmatite is underlain at the water's edge by a green quartzitic schist, and is overlain by a greenish-white argillaceous breccia from one to two feet in thickness. Overlying this is a mixture of quartzite (or infiltrated quartz) and rather hard green schist, containing a considerable quantity of hæmatite. This quartzose band is again overlain by light-green argillaceous on cericite schists, very much crumpled, but generally dipping at an angle of 60° and striking on the west side of the ore N. 50° E. and S. 50° W. Beyond this is twelve feet of light-green, soft, sericitic schist, and this then runs into the harder and more quartzitic schists, which comprise the rest of the whole exposure of Huronian rocks along this part of the shore.'

It may be of interest to note that Jeffry's 'Map of Canada and the north part of Louisiana' 1762, shows 'Iron Island' in Lake Winnipeg, a short distance south of the narrows, evidently referring to Black Island with its deposit of iron ore.

Islands in Hole Bay.

Islands in Hole Bay.

Opposite the western boundary of the Indian reserve, a group of small islands extends from near the shore northward to near the large island south of Black Island. On the northern island light-green crumpled schists are exposed. The strike is here S. 33° W., dip N. 57° W. $< 45^{\circ}$. In places the schist is soft and chloritic, while in others it is hard and quite silvery. The next two islands south show practically the same schist, but the strike swings round more to the west. On the western one, the strike is N. 10° W., and the dip southward $< 75^{\circ}$, and on the eastern one the strike is about west and vertical. On the large island to the north the beds run north-and-south, but turn to the westward on Black Island. In the group of islands to the south the strike bends round to the south-and-west, making a fold in the schists, one arm of which appears to touch along the south shore to near Clement Point. In the other islands in the group the strike is generally about east-and-west. The largest island, that nearest the south shore, is entirely made up of evenly bedded light-greenish brown-weathering schist, which breaks out in very long even slabs. This is evidently clastic and has probably resulted from the crushing of an arkose. The strike is N. 80° E., and the dip northward at an angle of 80° . It has also a linear arrangement of the crystals or an incipient schistosity at right angles to the strike, dipping S. 80° W. The surface is beautifully smoothed and grooved, the direction of the striae, being S. 62° W., earlier ones running S. 23° $< 32^{\circ}$ W. On the islands lying just to the north-east, similar rock is seen and included in it are a few



J. B. Tyrrell, Photo.

GLACIATED HURONIAN SCHIST, SHOWING EARLIER AND LATER STRIÆ AND GROOVING.
ISLAND IN HOLE BAY, LAKE WINNIPEG.

pebbles of granite. North of a long low sandy point, used by the Indians for a burial ground, somewhat similar schists or altered arkose is again exposed, found also to contain a few pebbles. The rocks are here vertical and the strike changes from N. 70° E. at the south to N. 57° E. at the north end.

A chain of small islands, five in number, lying in line from the mouth of the river to the east end of Black Island, show on the outer ones light-green schist, very much contorted. It has, however, a general dip S. 75° W. < 70°, and the rock exhibits in this section evidence of very heavy crushing and alteration, principally of the felspar constituents. The original clastic structure is still recognizable. On the small rock, opposite the graveyard point, near the mouth of Hole River, altered arkose beds are exposed, probably a continuation of the beds which outcrop on the north side of that point, as the strike is here N. 80° E., or towards the point; the dip is southwards at about 80°.

In the bottom of Hole Bay, clastic rocks, similar to those on the islands north of the west boundary of the reserve, appear on Dome Island, the largest of this small group. It is oval in plan, the longest diameter being parallel to the strike of the rocks. In a few places between the beds of the altered clastic rock, are found beds of green chlorite-schist. On Red Island, which lies just to the east, massive, green trap, cut by small veins of talc and dolomite, occupies the eastern part, while on the west side is an altered rock, consisting of a confused mixture of very numerous crystalline grains of calcite or dolomite, scales of sericite or chlorite, and yellowish stains of oxide of iron. The south shore is very much stained by the iron-oxide and some of the beds seem to be altered into a much harder and more compact form. The middle of the island is high and rough. The inner island, surveyed as a mining claim, is composed, on the west side, of the same beds as those on Red Island, while the trap forms its eastern extremity. The interior is composed of very much folded quartzite, hornblende-schist, &c., some of the bands being highly ferruginous.

Rocks of
Dome and
Red islands.

Along the east shore, near the mouth of Split-rock Creek, are some small islands, three of them near the shore and two others farther out. Those near the shore show beds of altered arkose or greywacké. The strike is approximately parallel to the east shore, and included in the beds are strings of granite pebbles. In places interbedded with the greywackés are dark-green schists. On the island lying outside or to the west of the group this greywacké often is coarser grained and cut by many, often large, irregular veins of white quartz. A small rock rising six feet above the water, well out from the islands, is com-

Islands near
Split-rock
Creek.

posed of a schistose conglomerate, in which the pebbles up to twelve inches in diameter, are of granite and the matrix is of a very much contorted green schist, dipping about S. 65° W. < 49°. This conglomerate resembles very much that exposed on the islands near the east shore.

Wannipegow or Hole River.

Wannipegow
River.

The valley of this river is denuded along the line of a narrow band of dark-green schist and eruptives, of Huronian age, and although the river follows the trough at the lower end, it cuts across it and touches a tongue of greenish-gray porphyritic gneiss before entering Lake Winnipeg in Hole Bay. The schists seen on the river above the Indian reserve appear to form a tongue extending to the west. It is thus represented on the map, as it is not probable that the schists end abruptly at the river. The band thus mentioned is denuded to form a trough for the upper part of the river and the Hole Lake basin, but near Lake Winnipeg it is partly divided by intrusive gneiss forming the centre of the peninsula ending at Clement Point. From the mouth, the course of the river follows along near the contact between the gneiss and the Huronian schists to the north-east, then it cuts across to the south and crossing the tongue of gneiss turns to the east and follows very closely along the strike of dark-green schists, which are apparently crushed greywackés.

The first exposure above the gneiss on the Indian reserve is a dark-greenish eruptive, in which the plates and crystals of hornblende are largely altered to chlorite, and the plagioclase to calcite. Massive, coarsely crystalline, hornblende-rock partly altered, is seen at the Indian reserve line, and above to the mouth of English River few exposures are to be seen of any rock. The banks are composed of clay, and rise from twelve to twenty feet above the river. They are evenly wooded with poplar up to twelve inches in diameter, mixed with which are a few spruce. Crushed greywackés are seen at the first and second rapids and on the long portage. These resemble a compact, dark-green, fine-grained hornblende-schist and include a few lenticular masses of quartz.

Hole Lake.

Several portages are made past rapids before reaching Hole Lake, and at each the dark schists are seen striking east, or slightly south of east, and standing vertical. In some places eruptives of the same dark colour appear, possibly interbedded, but at the entrance to the lake the schists are found intimately folded with a fine-grained greywacké, the clastic nature of which is shown in the microscopic section. The

foliation is very much contorted, and white vein-quartz is common in the rock. On the north shore, near the north-west angle, the beach is composed of boulders, while a bank of soft, gray clay rises behind them to a height of about fifteen feet, from which an almost level terrace extends back to the hills. These consist of green massive coarsely crystalline gneiss similar to that seen near the mouth of the river on the Indian reserve. It is cut by a few veins of red granite and comes out to the lake-shore half a mile to the east. From there on to the east the gneiss follows closely along the shore, and the schists form a narrow band. The contact was not seen, but it is noted that no granite veins cut the schists, but they cut the gneisses just beyond, and no inclusion of either rock is seen in the other. Near the east end of the lake the schist forms high hills along the shore, and the line of contact recedes somewhat from the lake, but numerous quartz veins or narrow strings of quartz, cut the schists. Massive greenstones are occasionally seen, but on the islands near the east shore thin-bedded schists occur striking S. 70° E., dipping northward at a high angle. The bedding is very wavy, and here and there in it are a few little strings of quartz. The south shore is indented with rounding bays, between which are well-glaciated points. The water is not deep and weeds grow all along the shore. The rocks strike generally along the shore, though at the east end the direction is sometimes to the south of west. The hills south from the eastern end of the lake show very hard compact light-green chlorite-schist striking west and standing vertical. Along the shore of the bay to opposite the mouth of the upper part of the river, green schists are followed by crushed and altered porphyrites, and similar porphyrites are found again at the south side of the outlet of the lake. Between these exposures all along the south shore dark-green schists are the only rocks exposed. These are probably squeezed eruptives associated with the porphyrites noted above. The southern edge of these rocks does not seem to be here well-defined and the south line of contact for all this area of Huronian is merely conjectural.

Contact with
Huronian on
Hole Lake.

The upper part of the river forms a long delta extending out into the lake for nearly three-quarters of a mile. The banks are rather low but are clothed with elm, ash, oak, poplar, birch and a little spruce. Above the delta the river becomes very crooked, winding from side to side of the valley and the banks rise gradually. About three miles up the first rock exposure appears and is of a hard, compact but thin-bedded, green schist striking east and dipping northward at an angle of 70°. Half a mile above, the river reaches the edge of the valley on the south side, and the green schists are exposed again. Shortly above

Upper part of
River.

this the river swings to the north, and crystalline schists, apparently fragmental rocks showing much crushing, are exposed on the hill-side.

A cut-bank, fifty feet in height, on the north side of the river shows at the bottom twenty-five feet of evenly stratified sand, in places coarse and red and in others white and very fine. In the sand are some thin bands of fine, gray clay, in one of which, ten feet from the bottom, were found three pebbles well striated. Over the sand is twenty-five feet of evenly bedded, light-gray clay with a few calcareous concretions. The top of this high bank is level and extends back 100 yards to the foot of a rocky hill, rising in all 100 feet above the river. The sand and clay are probably lacustral deposits and form a terrace, fifty feet above the river, or fifty-six or fifty-eight above Hole Lake.

Above this the river is rapid and shallow with a sandy bottom, and in less than a mile rounded boulders make their appearance for the first time, and are thickly scattered in the bed of the stream. High banks of sand and clay show the valley to be well filled with river deposit in this upper part, and as the present stream does not now touch these, it is evident that a large stream probably, at one time, occupied the valley.

English Brook.

English Brook English Lake lies in a basin to the north of Hole River, and the stream flowing from it, crosses the line of contact between the gneiss and Huronian, and then turns down the valley nearly parallel to Hole River for nearly three miles before joining that stream. The lower part is deep and about forty or fifty feet wide, without much current to the first rapid, two and a half miles up. Above that it is everywhere shallow and stony, often with a swift current. Below the first portage the country is largely alluvial, underlain by soft, dark clay wooded with poplar. Above, it becomes more rocky with little alluvial land. The rock exposures begin not far below the first portage and are of compact dark-green trap, in places schistose and undulating. A ridge of this rock runs up along the north side for half a mile, rising to one hundred feet above the river. The contact between the Huronian of the valley of Hole River and the gneisses bordering it to the north, occurs near the first rapid where bands of gneiss are first met. The portage is on the south side and is four hundred and seventy paces long, going back behind a ridge of the trap. A quarter of a mile above, another rapid occurs, and the rock shown there is a dark-greenish hornblende-granite, containing much

Contact of
Huronian
and gneiss.

plagioclase but no veins of granite. It seems generally massive, but in places it is foliated in a direction S. 65° E. and contains some strings of quartz. Before reaching the lake another rapid is met with, having a fall of thirty feet. The rock near the head of the rapid is a thinly foliated, gray gneiss with a strike N. 40° E. and a vertical dip. Near the head of the portage the rock is often much contorted, containing green hornblende bands, lenses of red granite and strings of white quartz. To the north, a hill, one hundred feet high is composed of a similar gneiss.

English Lake is deep and free from weeds and the shores are everywhere bold, rising abruptly out of the water with hardly a vestige of a beach anywhere. The rugged hills, black and green with lichen, are thinly wooded with pine. The rocks are granite-gneiss and hornblende-granite-gneiss on the west side and gneiss and schist on the east side. The strike where they are not massive, is in the direction of the length of the lake or about north-east and south-west. They all dip north-westward at angles ranging from 35° to 75°. The basin in which the lake lies, thus seems to have been excavated along the strike of a band of gneisses and schists lying alongside a mass of unfoliated granite to the west.

Shore of Lake Winnipeg—Hole Bay to Clement Point.

The dyke of dark trap which was seen on the eastern edge of several of the small islands lying near the east shore, reaches the mainland near the bottom of Hole Bay. On the east side the trap abuts against the porphyritic gneiss which runs along the east shore, and includes and surrounds many large rounded detached masses. On the west side the dyke is bounded by contorted green schist, quartzite with much vein-quartz, &c. This does not here extend out as far as the greywacké, but a few yards to the south, on a parallel line, this latter rock is found to succeed the schist. The south shore, west of the angle where the dyke disappears, is composed of a massive, dark-green rock, a greatly crushed granitic containing chlorite.

West of this, at the mouth of a small brook, a band of soft, green schist runs into the crushed granite noted above, with a strike N. 45° W. and a vertical dip. The contact is fairly regular, though a few strings of schist run out into the crushed gneiss. Near the mouth of the river the rock appears to be a crushed greenish gneiss, somewhat resembling that of the east shore of the bay. In places it is quite schistose, and then strikes S. 80° W., dipping south at an

angle of 70° . A band of wavy green schist crosses this, however, in one place striking N. 5° W. The rocks are in high rounded bosses, making a rough rocky shore both here and all around the bottom of the bay. It is well striated on the surface, in a general direction S. 66° W.

West of Hole
River.

At the bottom of the bay south of the point used as a graveyard by the Indians, the same greenish porphyritic rock is seen, but it is here cut by veins of green schist, that branch out very irregularly, having generally a much thickened triangular area at their junction. They vary in width from half an inch to several feet. The end of the point, and half way down the side into the bay, is composed of a light-green quartzite grit striking west and dipping south at a high angle. The shore is thinly strewn with boulders, and overlain by blue clay up to ten or fifteen feet. The north shore is rougher, and the light-greenish grits standing on edge, run parallel to the shore and form cliffs eighteen feet in height and almost perpendicular. These grits are succeeded, in the same section, by coarser, partially recrystallized arkose sandstone, holding pebbles of granite, many of which are drawn out along the line of cleavage. Unfortunately the contact between the arkose and the porphyritic gneiss just to the south is covered, but a little point between the two exposures shows a very much reddened and altered rock, consisting principally of calcite and dolomite, stained by iron-oxide. The porphyritic gneiss appears on the shore just west of these cliffs and included in it are bands of green schist. They appear again at the point, which is the western extremity of the Indian reserve, and a mile to the west of this the point is occupied by green schists and the porphyritic gneiss. The contact shows the schist to be included in bands in the porphyry.

East of
Clement Point

All along the shore to Clement Point, the greenish porphyritic gneiss is seen on the points, and green schists are caught up in it and strike in an irregular manner; but the small islands off the points show that the Huronian band must underlie the lake in the vicinity, and that the line of contact follows closely along the shore. Similar quartzite grit and arkose is exposed on two of the islands, and on a third nearer Clement Point, massive serpentine is found, much jointed and cut by veins of dolomite.

Contact
following
shore-line.

This shore thus shows beds referable to the Huronian only on the points, while the rocks to the south seem to belong to a similar series of squeezed and partly altered gneisses, with that found along the east shore of Hole Bay; and, probably the foliation becomes less distinct inland, as is also the case in that vicinity. The exposures on the

Hole River in the Indian reserve are probably parts of the same mass, and as is noted there, they are almost massive.

Shore of Lake Winnipeg—Clement Point to Winnipeg River.

Clement Point is long and low, and closely surrounded by a pavement of boulders, which are chiefly of granitoid gneiss, though a large number of the smaller ones are of limestone and a few of the slaty schist. No rock in place is seen and none of the boulders are very large. The point is overlain by a sandy clay, but a long beach of fine white sand leads up to it from both sides. Between these beaches is a piece of flat country ten feet above the lake. Many irregular cobbles of sandstone are seen, and at the second point in the bay toward Bad-throat River a small cliff shows sandy till overlying two feet of white and brown, stained, soft horizontal sandstone, an outlier of the basal beds below the Trenton. An island off this point shows a massive even grained granite broken by a few irregular jointage planes.

The islands in this bay are all bosses of rock. One opposite the mouth of the river rises twelve feet above the water, and is of fine-grained gray granite, covered by stratified blue clay on which some spruce is growing. The beach from Clement Point to the mouth of the Bad-throat River is generally sandy, with the exception of a few boulders at two or three points, and no Archæan rock is to be seen except just at the river. The northern point is composed of an amphibolite-schist consisting mainly of hornblende and finely granular quartz as a matrix, and is derived probably from a diorite subjected to intense dynamic action.

South of the mouth of the river the rock is composed of a very compact dark-gray schist striking N. 62° W., vertical. The small rocky islands lying immediately west from this are found to be composed of a dark-gray evenly banded schist, somewhat coarser on the outer islands and more felspathic. In places on the outer islands the rock is almost massive or occasionally well bedded, but the strike is generally irregular. On the most southerly island of the group, red, coarse pegmatitic granite with a distinct lamination east-and-west forms the mass of the island. It includes many masses of coarse gray gneiss highly micaceous. In the largest of one of these is a wide vein of light-gray slightly micaceous gneiss that has probably been a vein of granite cutting the schist. On the main shore the contact of the pegmatite with the gneiss is seen.

Bad-throat
River south-
ward.

McDermott
Point.

The shore from the river to this granite dyke or mass is composed mainly of dark-gray rock approaching a mica-schist. Toward McDermott Point the rock is a mica-diorite-gneiss becoming at the point a much coarser diorite-gneiss with less mica. The strike is here S. 24° W. with a dip westward < 25°. It is cut by many veins of granite, some of which are light, while others are dark-red and fine-grained. McDermott Point is low and wooded with high poplar. Many low rocky shoals lie off it, apparently of dark gneiss. Along the shore to the southward the gneiss is seen to be very much cut up by granite dykes. Several points north of Sand River show exposures of dark epidotic granitite-gneiss very much cut by pegmatite veins. The strike is varied, but generally nearly east-and-west, and the dip varying from vertical to an inclination either to the northward or southward. From the point, to near the mouth of Sand River, the shore is low and apparently even, with a beach of sand and occasionally a few boulders. Bosses of rock are seen here and there rising above the beach. Their surface is generally smooth and glacial striae are frequently seen. Two sets crossing each other were observed on a point north of Sand River, running S. 75° W. and S. 50° W.

For two miles north of Sand River the shore is about six feet above the lake, and the outer slope is often covered with grass. The beach is a soft clay and the country in the vicinity of the Sand River is low and flat. An alluvial plain stretches back up the river for a considerable distance.

Rocks on Sand
River.

The point south of the mouth of the river is composed of low outcrops of massive, gray gneiss cut by veins of red pegmatite. It is massive, however, and contains much plagioclase. The mica is mainly altered to chlorite, and on the whole the rock is not so fresh as the exposures north of the river. The first rock exposure up the river is a dark-gray gneiss striking S. 40° E., and includes some irregular drawn out masses of mica-schist. The next exposure shows a boss of hornblende-granitite-gneiss, cut by a few narrow veins of red pegmatite. The highest exposure seen, about four miles from the mouth, consisted of a foliated granitite or biotite-gneiss striking S. 55° E., vertical. The river at first is from sixty to one hundred feet wide, but above the first rock exposure it is narrowed to about fifty feet. The banks are generally three to four feet high, level and dry, wooded with aspen.

Sand River
southward.

The shore of Lake Winnipeg, south from Sand River, is generally low with a sandy beach, and low exposures of rock are seen near the water's edge. Dark-gray gneiss, cut by many wide veins of red granite, occurs near Sand River, followed by a long strip of low shore apparently showing no rock for a couple of miles, when coarse red granite

containing a few inclusions of the dark gneiss shows in a low exposure. Low shores without any rock exposures stretch to within three miles of Black River. Half way a small reef shows the rock to be a red granite foliated N. 65° E. On the first point north of Black River, at a distance of about three miles from the river, the rock is a beautifully banded red and dark-gray gneiss. The red bands are often beaded; the dark bands appear to be epidotic and are probably decomposed rocks similar to the mica-diorites of McDermott Point. The strike appears to be N. 85° E., dipping S. 15° E. at about < 70°. In the vicinity, the reefs and points to the south are all of a quartzose granite, rather massive, with a fairly definite foliation N. 65° E. At the mouth of the river, on the north side, are exposures of a red massive biotite-granite. Small exposures of similar rock are seen in the bay to the north and up the river for nearly four miles. North of
Black River.

The point on the south side of the river is composed of a white granite, containing large crystals of felspar. It also holds irregular inclusions of dark-gray thin-bedded gneiss, striking S. 65° E., and is cut by a few veins of red granite. Many rocky reefs lie outside a line, joining this point with the points to the south, and at a distance of three miles the shore is cut back to the east, leaving a low point on which is piled a great number of transported boulders. Beneath, the rock is seen to be still of the same character as the last, with a more pronounced foliation, and somewhat darker and finer-grained. Many veins of red granite are seen cutting through the gray gneiss. In the bay to the south many boulders of gneiss and Trenton limestone are distributed along the shore. A low cliff of re-assorted till shows at its base, boulders with patches of hard compact till containing limestone fragments. The next point, a mile to the south-east, shows dark-gray, schistose biotite-gneiss, very much cut and broken by veins and masses of reddish and gray granite. South of
Black River.

Three miles from Point Metasse a high rounded rock forming a point, is composed of evenly banded dark-gray, schistose granitite-gneiss, striking S. 67° W. and dipping N. 23° W. < 70°. It contains many interbedded strings of red granite, which in places swell into wide veins cutting across the gneiss, the latter becoming very much contorted. On the next point, past a few small islands showing dark gneiss cut by red granite veins, a gray epidotic granitite-gneiss well foliated S. 70° W., is cut by very few thin veins of red granite, and also long lenticular pointed strings of a darker, more massive hornblende-granitite. The edges along the lines of contact of the two gneisses are frayed, caused by the apparently broken ends of the gneissic foliae. North of
Point Metasse

Point Metasse At Point Metasse no rock is seen absolutely in place, but here and on the reefs off the point are many large boulders of gneiss. The surface is about twelve feet above the water and a scarped face shows it to be composed of a very sandy till with many boulders, evidently a morainic deposit. It is overlain to the south-east by a very well stratified dark-gray clay, holding toward the base a few pebbles, chiefly of limestone. Toward the mouth of Winnipeg River, the shore is mostly low with a beach of sand and clay. The country behind is from ten to fifteen feet above the water, and cliffs of stratified clay, at first in small exposures, are seen rising gradually to nearly fifteen feet as the river is approached. Very little rock is exposed and the first is on a small island, one mile from the river. It is of a dark, red and gray hornblende-biotite-granite-gneiss, striking east and west, cut across by a wide band of red granite. This granitic gneiss is exposed on the north side of the river for a mile and a quarter up from the mouth, and there comes in contact with large masses of a red biotite gneiss, which is cut by many veins running from the granite.

Traverse Bay.

Manigotagan or Bad-throat River.

Manigotagan River. The river from its mouth to Jonasson's mill is deep and a quarter of a mile wide. The banks are composed of stratified blue clay without boulders, fifteen feet above the water and wooded with beautiful tall aspen and spruce,—a country evidently fitted for agriculture when the forest is cut down. At a mile and a half up, on the south shore, there is a little exposure of dark-gray micaceous schist striking east-and-west, dipping S. $< 75^\circ$. Along the line of strike run a number of little narrow lenticular veins of white quartz. The rock is generally covered by twelve feet of blue clay and shows glacial striae running S. 57° W., while the lee side is equally well striated in a direction S. 27° W. The road from the mill to the falls, leads over good clay land and near the falls a ridge of mica-schist is crossed. The fall is twenty feet high, and the river at the foot is only forty feet wide. Steamboats run up to the foot of the fall. The rock exposed is here a dark-gray mica-schist standing vertical and striking N 85° W.

Above the falls, the channel is deep and seventy yards wide, with banks fringed with rice, behind which are thick woods of aspen with some spruce. Very few exposures of rock occur, and these consist of moss-grown points of dark schist, the same as that seen at the falls. The next portage, at Poplar Falls, is on the east side of the river, where there is a descent of fifteen feet. The rock consists of a dark-green thinly laminated hornblende-epidote-schist which assumes a

Poplar Falls.

gneissic aspect on one side and on the other passes to a fine-grained felsite. It strikes N. 60° E. and dips N. 30° W. < 70°. It is cut by many veins of red orthoclase-granite running generally with the strike of the gneiss and varying in width from three feet to fine strings. Just above, the rock is apparently massive, rising in high rounded hills probably of gneiss. At the next fall, a short distance above, the river descends five feet over a fine grained greenish and red biotite-gneiss with a generally massive appearance, but foliated in the same direction as at Poplar Falls.

About a mile and a half farther up is another portage running up the left hand side of a rapid coming through a narrow cut between rounded gneiss hills. The portage is partly through low scrub and partly over a bare rocky knoll. The rock is a gray gneiss the same as the last with an indistinct crystalline foliation striking west. Above Poplar Falls.

The river in the last stretch is about the same width as before, but rounded bosses of rock are seen in many places, and the woods are thinner, of pine and small poplar. The rock all the way is a gray gneiss the same as at the last portage. At the foot of this portage light-gray alluvial clay without pebbles, is seen to five feet above the water. The higher parts of the rock are covered in the depressions with gray till with pebbles. Glacial striæ are not shown here, the rock being very much weathered and covered with a growth of lichens.

After passing a small rapid the next portage is on a small island. There is here a fall of three feet and the rock exposed is an orthoclase-biotite-granite-gneiss striking S. 70° E., cut by a few veins of red granite. At a sharp bend to the south the river is narrow, flowing between steep rocks and falling five feet. Past this there is a portage on the west side through the woods, over blue clay without pebbles, similar to the alluvial clay of Lake Winnipeg. Higher up, bouldery till is found on the rock. The rock exposed at the fall is a similar gray gneiss striking S. 85° E. The Cascade portage, about a mile above, is nearly 300 yards long through low bush on the east side of the river, past a cascade with a fall of twenty-five feet. The rock is a gneiss with a larger percentage of orthoclase than in the rocks below. The strike is about N. 60° E. The rocks here are cut by many veins of red granite, and the surfaces have been well glaciated, the north-east sides being rounded and the south-west, broken. The surfaces are everywhere weathered, so that most of the grooves and striæ are obliterated, but a few of the former are seen running S. 52° W. They are not on flat surfaces, but probably indicate the direction of ice flow very closely. Cascade portage.

Smooth-rock
portage.

A small cascade of four feet, about a mile above the Cascade portage, shows similar gneiss striking N. 85° E., cut by a few veins of red granite. The river runs between rocky shores all the way, and up to the Smooth-rock portage, many small rapids occur, past which no portages need be made, while the general course of the river is quite straight, running approximately with the strike of the gneiss. High rounded bosses of rock show all along the banks, between which are little bays apparently underlain by light-gray clay, wooded with poplar. The shores are lined with rice and rushes. Red orthoclase-gneiss striking N. 85° E. and standing vertical shows at the Smooth-rock portage. A dark, banded gneiss or schist with lighter lenticular inclusions, is exposed at the next portage above. The country is generally low without much rock in sight, and is well wooded with white and black poplar, some spruce and a few oaks and ash. A little above this and opposite the mouth of a small creek, high hills rise on the south bank, composed of mica-schist very much folded, but generally striking up the river. The top of a hill, sixty feet high, is a fine-grained, white-weathering granitite-gneiss, with apparently no bedding and nearly massive, breaking readily when struck by the hammer. On each side of this are heavy beds of white, coarse, crystalline granite, folded with the bands of schist.

Pillow Falls.

Above this the river runs along the strike of the rocks, and a ridge follows on both sides up to Pillow Falls. Here the rock is a mica-schist, striking S. 75° to 80° W. It is interbedded with a fine-grained granitite-gneiss in thick and thin bands along the strike, but also often in lenticular masses or strings, running out at both ends. In some bands of the schist the mica is entirely silvery white. Over the rock is a soft light-gray, slightly sandy clay without boulders, while in other places many boulders, chiefly of gneiss are scattered through a light-gray clay.

A mile above this beautiful fall is another of fifteen feet, at a low point in a ridge of schist which here crosses the river. It runs about east-and-west, and the river crosses it from the south. These ridges are probably formed by the presence of many lenticular bands and strings of a white pegmatite included in them, rendering the whole much harder than the surrounding rock. South-east of the schist, a wide band of massive, fine-grained, light-gray granite rises in rounded hillocks to a height of thirty-feet above the water, followed again by schist with lenticular inclusions of granite, etc., the same as that seen at the last fall, striking here S. 50° E., and dipping S. 40° W. < 80°. Occasional bands of schist were noticed in the granite area just passed.

The next portage is occasionally made by going up a short branch from the south and then carrying across the point. A short portage can, however, be made on the north side, near the rapid. The rock is a light-gray granite, but across on the south side mica-schist is seen dipping at a high angle, and many irregular fragments of schist are included in the granite which surrounds them on all sides. Below the rapid, on the north side, the schist is seen to abut against the granite, and is much folded and contorted at the contact.

From Turtle Lake, the river falls in a cascade of twenty feet, and at the foot the rock is a gray mica-schist in very irregular bands, very much cut and broken by irregular masses of red granite, the felspar of which is in places largely plagioclase. It is also cut by regular bands of the light-gray granite. The rock at the upper end of the portage consists entirely of the light-gray granite, and this rock forms the hills, ninety feet high, on the south side of the river, extending all round the south shore of the lake. These hills are conspicuously bare of all vegetation, and show out white, through the few stunted pines. The rock is in places very much cut by reddish granite veins, these in places composing about half the mass. Mica-schist is seen on the first point passed in the lake, and also across on the north side, but passes into a gneiss and then is so cut up by pegmatite veins that the foliation is lost. Outlet of
Turtle Lake.

High hills of a bright red granite-gneiss rise on the south shore of Turtle Lake. Turtle Lake, while in the distance, to the south, the hills of white granite are also seen standing out in sharp contrast. The contact was seen only at one place, the two being separated by a vein of coarse red pegmatite.

The white granite includes many bands of mica-schist, running approximately parallel to the contact, which is in general in a straight line, but in detail cuts the foliation of the schist. In another place the two are seen in sharp contact, and the white granite contains many inclusions of gneiss, which in turn also hold inclusions of the schist. Intrusive
granite.

Above the lake to the next portage the river is nearly straight. The north bank is low, without rock and wooded with aspen. On the south bank mica-schist is exposed, striking parallel to the shore and dipping south $< 45^\circ$.

Four rapids with portages are passed before reaching Caribou Lake, and at each, mica-schist is seen dipping south, and south of the river the white granite hills are in view all along. Caribou Lake is bounded

by high hills to the south, while to the north, the country, though hilly, is more or less sloping and wooded, and the shore is very largely composed of boulders strewn along the beach. The rock exposed on the south shore consists of thin-bedded gneiss, striking S. 37° E., dipping south-westward $< 65^\circ$, but on the north shore it is reddish granite-gneiss broken by many horizontal jointage planes. The foliation in this is very indistinct, and on the last portage before reaching Muskrat Lake, thin schists seem to be folded into it.

Muskrat Lake Muskrat Lake, also called Rat Portage Lake, is irregular in outline, and, as will be seen from the map, consists of two bays, a large one on the west and the other narrower, running to the south, into which a small stream, the southern branch of the river, enters by a chain of little lakes. The northern branch enters the lake about a mile to the east of the outlet. The rocks observed along the shore of the western arm are mainly granite, but the north shore consists of evenly laminated gneiss and mica-schist, with white granite cutting it at the outlet and running approximately parallel to its strike, which is here N. 80° E. Near the north-west corner of the lake, red granite makes its appearance, cutting into the gneisses to the north, and it is seen that a large body or area of this coarse red granite occupies the country to the west and bordering the western shore, but the margin of the lake shows many exposures of very much altered gneiss, and many masses of various sizes are seen included in the red granite. Smooth rounded hills almost devoid of timber, rise to a height of ninety feet and occupy the country bordering the western shore, while the gneisses mentioned above, on the lake-shore strike in some cases towards this mass and in others to the southward along the shore.

The point between the two branches of the lake is mainly made up of red granite, but exposures of the gneiss are noted along the northern part. The eastern bay is mainly in a trough on the strike of the gneisses, while the narrow channel running to the south is in the red granite. At the inlet of the south branch of the river, a ridge of schists and gneisses running east-and-west cause a barrier, over which the stream falls fifteen feet, and above this is seen a wide lake-expansion with several islands. This is excavated along the strike of the schists and is evidently formed from the denudation of the softer beds. The islands are arranged in an interrupted chain from east to west, and are apparently formed from a band of gneiss. South of this, red granite again makes its appearance.

The northern branch of the river up to the first fall, which is ten feet high, runs between white granite on the north-west and thirly

foliated micaceous gneiss on the south-east side, striking up the river and dipping south-eastward at a high angle. The fall is of the character of a cascade flowing over the white granite. The next fall above is about twelve feet, and is over thin-bedded gneiss. The white granite is not exposed on the river above the first fall. Another mile up and a fall of twenty feet is passed, where a hard, fine-grained schist makes its appearance, striking N. 80° E., dipping southward at a high angle. This is a much sheared and stretched chloritic rock, a more highly altered stage of the micaceous gneisses of the lower part of the river.

Long Lake occupies the valley of the upper part of this stream, and Long Lake. discharges by a long shallow rapid, past which it is necessary to portage canoes. The rocks exposed are portions of the band of green schists seen at the falls just below, and their strike runs with the direction of the lake. Fine strings and veins of quartz were noticed cutting the schists, and in tracing these beds west they gradually merge into the coarser gneisses of the north-east shore of Muskrat Lake. The shores of this narrow lake are rounded hills of the green schist, with low land between, wooded with poplar and a little spruce. At a few places stratified clay, evidently alluvial, was seen.

Black River—north branch.

The two streams, the north and south branches of Black River, Black River., empty into a crooked narrow bay in the centre of the Indian reserve. These two streams are said to rise very near one another, but they spread apart and then gradually approach. The north branch is about the size of Rice River, and there are many rapids necessitating portages in ascending it to the long portage to Muskrat Lake. At the first rapid the river runs between two walls of red granite and falls about three feet over boulders. Similar granite is seen at the second portage, and at the third a well banded red and gray gneiss, probably near the junction of the red granite with darker gray gneiss, is seen. The strike of this rock is N. 50° W. At the fourth and fifth portages red massive biotite-granite, similar to that at the second portage occurs. Several small rapids are to be found between the fifth and sixth portages, and exposures of a light-coloured granite appear. The banks of the river in this vicinity are low and covered with poplar. Low exposures of the whitish granite, are occasionally seen with in one place a contact with a dark mica-schist, apparently a narrow band included in the granite. At the seventh and eighth portages the rock is a highly micaceous granitite-gneiss, cut by veins of the white granite. Above the eighth portage the river maintains its general width of about fifty

Fourth
portage.

Eighth
portage.

feet. The water is of a dark-brown colour, and slightly turbid. The banks are composed of clay, and are generally five to eight feet high, and wooded with poplar and a few large white spruce. Many ash trees overhang the river all along, and small oak grows on the rocky knolls. On the whole the country up to this point is rich and alluvial, the rock forming a very small proportion of the surface. Dark-gray gneiss, well foliated, running N. 70° E., occurs on the ninth and tenth portages. Interbedded bands of the white granite are found in the gray gneiss on the twelfth and thirteenth portages, and on the next two the bedding is indistinct.

Seventeenth
portage.

Berry Rapid.

Twenty-
fourth portage

The banks gradually rise and become more sandy, without boulders. The trees are Banksian pine, spruce, poplar, ash and elm. At the seventeenth portage, fourteen miles in a direct line from the mouth of the river, the rock is a dark-gray micaceous gneiss, nearly horizontal, or dipping N. 25° W. at about $< 20^\circ$. At the next fall, or the eighteenth portage, the rock is a coarse, gray gneiss, rather irregularly foliated, but generally striking about east-and-west. The river from the last portage averages about forty to sixty feet wide, overhung with aspen, ash, and some large spruce. Here and there are little low exposures of thinly foliated gneiss generally dipping northward at about $< 70^\circ$. The banks are from three to eight feet above the water. At Berry Rapid, the portage (nineteenth), is past a fall of six feet over smooth rock, a greenish-gray gneiss, with orthoclase and plagioclase, very irregularly foliated. Over the rock the soil is a white, sandy till. The winter trail from Fort Alexander to Muskrat Lake crosses the river just above Whirlpool Rapid, and seems to follow a sandy plain covered with Banksian pine. On the river up to the twenty-first portage, the banks are fairly level six to ten feet above the water, underlain by fine white sand. Low rounded bosses of gray gneiss occasionally project from either side into the river. Between the twenty-second and twenty-third portages, hills rise to fifty feet above the sandy plain which extends to the twenty-fifth portage. On the twenty-fourth, the gray gneiss exposed shows great crushing. About twenty-two miles in a direct line from the mouth, the river crosses an extensive muskeg, and above this rougher country is entered, rising in rugged and almost bare hills. A portage, the twenty-sixth, is at the east end of the marsh, where the rock is an evenly banded very much squeezed and altered gray gneiss, striking parallel to the river and vertical. In places it is interbedded with light-gray coarse granitite-gneiss, also very much squeezed. Winding through this rough country for a couple of miles farther, the river is found to issue from a long narrow lake-basin, now filled up, and forming a valley a quarter

of a mile wide, lying nearly east-and-west. To the south a short portage leads to a small lake on the head-waters of the south branch. The rock in this vicinity is of the dark-gray gneiss, striking E. 25° S. To the north similar rock is seen for several miles in long bare hills, between which are narrow beds of muskeg wooded with small spruce and larch. An Indian trail leads from this branch of Black River, by a series of small lakes and streams, to Muskrat Lake, on Manigotagan River. An Indian sketch is shown on the map, and serves as an indication of the route between the two points.

Black River—south branch.

The banks to the first rapid, half a mile south-east of the Indian South branch reserve are sloping and alluvial, wooded with a forest of aspen. The stream here contains little over half as much water as the north branch, and the water is very dark and muddy. Above the rapid the stream is about forty feet wide and overhung with aspen. On the south side, is a low glaciated exposure of dark-gray hornblende-schist, containing in some places a considerable amount of pyrite. It strikes S. 25° E. and dips N. 65° E. at $< 40^\circ$. It is cut by a vein five feet wide, of light reddish-gray pegmatite-granite.

Winnipeg River.

The Hudson's Bay Company's establishment at Fort Alexander, is situated on the south-west side of the river, on the top of a bank of blue clay, that rises twenty feet above the water. The ground in the immediate vicinity is cleared, and behind is a forest of white poplar. The river water is brown but clear, flowing smoothly in a wide and deep channel. The fall from Lac du Bonnet to the level of Lake Winnipeg, is given as about one hundred and thirteen feet. This is mostly distributed at several beautiful falls and rapids, between which, the river-stretches are broad and deep. Upward from near the fort, the out-crops of the underlying rocks are mainly of red granite, and at the Manitou Rapids on the western edge of township 18, included angular fragments of red gneiss are frequent. The river there is narrow and deep, rushing between rounded bosses of rock. Pine Fall, two miles to the east, has a steep descent of over five feet and above are several lesser ones. At the fall similar granite and hornblende-granite are exposed, and little foliation is seen in the granite at the short portages above. No boulders are noticed along this stretch of the river, the country being all covered by a thick bed of alluvial blue clay wooded

Silver Falls. with aspen. From these portages to Silver Falls on the north boundary of section 1, Tp. 18, R. X., little rock is seen, the banks being of alluvial clay, sloping up gradually to woods of aspen. At the falls the rock is a red hornblende-granitite, over which the water flows in a single cascade with a fall of twenty-five feet. Above Silver Falls the river is generally wide and with a light current. With the exception of two or three low rounded bosses of granite, the banks are composed of blue alluvial clay without pebbles or boulders, and wooded with aspen.

White-mud Falls. The end of this wide stretch reaches to the line between sections 31 and 32, Tp. 17, R. XI., where a cascade of twenty feet, called White-mud Falls, breaks over a mass of red granite containing a few inclusions of dark-gray gneiss, and cut by many veins of red pegmatite. At the lower end of the falls, the portage ascends over the clay to a height of thirty feet above the water, while at the upper end the bank is only ten feet.

Big Bonnet Falls. Another lake-like expansion after leading to the east for three miles, turns southward in a narrower channel to a rapid with a fall of six feet. On the north side a portage is made over smooth rock, a hornblende-granitite of light- and dark-gray colour. Above, to Big Bonnet Falls, the river has low rocky banks with clay generally filling the depressions. On the portage, which is three-quarters of a mile in length, a knob of granite protrudes through the clay at the middle of the distance, and toward the upper end the clay rises gradually to a height of twenty-five feet above the river. The next portage is at the west end of an island, where there is a descent of about four feet. Similar granite rock is exposed at several places in the interval, and at the portage it includes a few masses of a darker gneiss. The last portage to Lac du Bonnet is over the rocky end of a little island past a fall of five feet. The rock is a similar red granite, and the surrounding country is covered with but a slight thickness of alluvial deposit.

Lac du Bonnet.

Lac du Bonnet The southern arm or continuation of the river extends to the southern edge of township 16, and the shore of the eastern part is generally low and wooded with poplar, with, occasionally, stretches of sandy beach and points consisting of rounded bosses of granite. The rock is a coarse, red, micaceous granite, quite massive, and free from inclusions and granite veins. The depressions in the rock, up to a height of eight or ten feet above the water, are filled with soft alluvial clay, and the shore is very free from boulders. The water close to the rock is clear

and in places deep, but in the immediate vicinity extensive beds of rushes indicate shallow water and a muddy bottom. Across on the west side, a band of reddish-gray gneiss, showing a slight banding N. 50° W., forms the point in section 14. The rock-surface is well-polished, and two sets of striae were seen, the first running S. 25° W., and the later ones south-west. Boulders are scattered round the point, chiefly Archæan, with a few of trap and many of limestone. The surface is covered to a height of twelve feet above the water with a soft, gray, alluvial clay, and there is no sign of boulder-clay beneath.

The eastern branch of this lake, is shown on the map from a survey by Mr. J. B. Tyrrell. It is seen to consist of two expansions. Around the shores of the first, red granites are the prevailing rock, but as the narrows to the second is approached, dark-gray gneisses and schists occupy the island in the channel and the point to the south. These strike S. 60° E., and appear very much squeezed and altered. The schist on Windigo Island, situated in the narrows, contains columnar individuals of tourmaline, and numerous patches of calcite and sericite or epidote, evidently a contact product. Reddish gneisses occupy the north shore, and strike about east-and-west.

Around the south shores are found gneisses standing nearly vertical, running to the east. At the east end a depression in which the Oiseau River runs, seems to follow a trough of altered, eruptive and gneissic rocks. At the mouth of the stream the rock is a chlorite schist, showing intense crushing. Red and green schists, followed by a chlorite-schist, the altered form of an eruptive rock, are seen just to the north of the stream and strike up its valley. The north shore, with the exception of a point near the narrows, is occupied by greenish felspathic schists of fine grain, very dark in colour, striking easterly, and dipping northward < 55°. A mile east of Windigo Island fine-grained rock resembling a dark quartzite, striking S. 65° E., is followed to the west by coarser granitite-gneiss striking about east. The contact between these last two is not noted, but the strike and dip of the dark rocks is not apparently parallel to the coarser gneiss, and the probability is that the contact is an eruptive one and that the rocks of the valley of the Oiseau River are part of a lenticular area of Huronian rocks, west of Windigo Island.

Winnipeg River.—above Lac du Bonnet.

Above the lake the river is a beautiful quiet stream but with swift current where rounded bosses of massive reddish granite contract the

Whitemouth
River.

channel. In the southern part of township 15, the rock is overlain by blue alluvial clay, which rises to a height of fifteen feet above the river, and then apparently extends back in a level plain, wooded with poplar. On the beach are many boulders of limestone, both mottled and cherty. The first exposure of till is found on section 6, Tp. 15, and is compact and white, with many pebbles of limestone. The till is just such as has been found to be derived from the vicinity of areas of Trenton limestone, and evidently indicates the presence of it in the vicinity. Through Tp. 14 the river flows with a constant swift current, in a few places forming rapids where obstructed by boulders. A very few low exposures of rock are seen, all of granite, but the banks are very uniform and from twenty to thirty feet high, composed of an unstratified white till, containing boulders of limestone and gneiss. This till is overlain by a few feet of dark blue-gray alluvial clay. In section 5, Tp. 14 an outcrop of coarse biotite-gneiss rises five feet above the water, striking N. 70° E. and standing vertical. It is essentially the same in composition as the granite of the lower part of the river. No Cambro-Silurian limestone or sandstone was seen in place, but a number of little creeks flow in from the west side, which may be fed from the sandstone. Up to the mouth of Whitemouth River the banks are about the same as lower down, except that there are more rock outcrops. The latter stream flows into Winnipeg River over a smooth ledge of rock with a descent of about ten feet. The rock is a dark-gray, well foliated hornblende-granitite-gneiss, striking east and standing vertical. It is cut by veins of fine-grained gray granite and again by many veins of a coarse red granite. Light-gray till everywhere overlies the rock, and the country is well wooded with poplar and a few oak.

A small island, just off the mouth of the river, has its surface well smoothed and glaciated in a direction S. 63° W. and it also shows another and earlier set of grooves running S. 30° E. The next little island further up the river has a wide flat surface and shows the glacial markings very much better, The later set being seen to run S. 60° W. and the earlier S. 33° E.

Shore of Lake Winnipeg—Winnipeg River to Red River.

Catfish Creek. From Fort Alexander to Catfish Creek a bank of stratified clay from ten to fifteen feet high extends, generally scarped by the washing of the waves against its base and often beautifully carved out to little caves and pillars. Catfish Creek is a small but deep, sluggish stream thirty feet wide, and overhung with willows. It rises just west of Lac du Bonnet and flows through a muskeg for a great part of its

course. From Catfish Creek to the next one west—Jackfish Creek—Jackfish Creek the shore is very similar to that to the east. Sand spits run out into the lake and the shore is shallow. Sand beach forms a long strip bordering the shore to the corner of Tp. 19, R. VII, and behind this stratified clay continues in a cliff of ten feet. Boulders then become thickly strewn along the beach and the bank behind rises with a moderate slope to a height of thirty feet. The top for about six feet is composed of a sandy till with large and small boulders, having the appearance of a ground moraine; below, the soft beds of the Winnipeg sandstone appear to extend down to the water and are seen for about a mile along the shore. A low strip of country extends across the narrow isthmus which is the southern part of township 20, R. VII. The eastern side of the peninsula is higher than the west and is very similar in contour to that of Elk Island just to the north. Beds of stratified sand and clay form cliffs very similar in appearance to the Winnipeg sandstone and probably the peninsula has a nucleus of these beds. The north shore is of boulder-clay with a level surface fifteen or twenty feet above the lake, and the beach is thickly strewn with boulders. On the west side many large slabs of mottled, Trenton limestone containing *Maclurea Manitobensis*, etc., are lying, evidently close to the parent rock. Behind the beach in section 15, is a cliff twenty feet above the water, composed chiefly of clay, often with many large and small boulders.

South of Elk
Island.

South of the point in Section 16 is a high cliff of sand, which is probably recent and not part of the Winnipeg sandstone. The west point of section 9, is a cliff of clay thirty to forty feet high, very sandy and containing some interstratified beds of sand and also some boulders from the soft sandstone beneath. South-east of this the land lowers and is composed of till, occasionally overlain by a little blue clay. A beautiful harbour is formed in the bay between this peninsula and the mainland to the south, by a bar of sand and gravel reaching out from the south. The country in the vicinity is wooded with poplar and spruce, but about fifteen feet above the lake, a level green sward of short grass affords a good camping place.

Point Grand Marais is surrounded by boulders and behind them is Point Grand Marais. a cliff forty to fifty feet high, composed apparently of sand containing many large boulders. This forms a narrow terrace with low land behind. A deep bay on the north, across the mouth of which two bars nearly meet, forms a natural harbour. Opposite the marsh, to the south, a sand-bar terminating in a hook, also affords shelter for small vessels. The land east of the bay rises to the north and from the northern part of Sec. 33, Tp. 18 a smooth sandy plain rises with a

gentle slope to a height of thirty feet above the water, while on the beach at this latter point is a low exposure of dark-blue alluvial clay. Another terrace above is here also noticed with a steeper slope. This rises to an additional height of thirty-six feet or a total of sixty-six feet above the lake. Its surface is a level sandy prairie wooded with occasional pine, and its scarped face shows it to be composed of horizontally stratified alluvial sand, with pebbles of gneiss, etc. Crossing this terrace with a width of about two hundred yards on the Fort Alexander trail, another moderate sandy slope strewn with large boulders is ascended to an additional height of sixty-five feet or to a total height of one hundred and thirty-one feet above the lake. The top has a moderately even surface of coarse sand with a few boulders in some of the depressions. This ridge runs N. 25° W. and S. 25° E., and beyond, past a depression running parallel with it, is a hill of about the same height. This has undoubtedly a morainic centre, probably deposited in shallow water.

South of the marsh at Grand Marais the beach to Balsam Bay is composed of boulders, behind which is a cliff ten to twenty feet high, composed of sandy till containing boulders.

Balsam Bay. At Balsam Bay, the land rises to a terrace about thirty feet above the water behind which, on the trail back from the lake is a sloping sandy plain, dotted with a few boulders, terminating in a more abrupt slope, at the top of which is a rounded ridge, fifty feet wide and three feet high, composed of rounded cobbles. This is clearly an old shore-line and is probably about sixty feet above the lake. Behind it, the sandy hill or ridge, rises to a height of about one hundred feet above the lake, the summit being often composed of many boulders set in loose sand. At three-quarters of a mile from the lake the land falls again to a wide valley in which there are no boulders. Gray sandy and pebbly till is also seen at many places, on the surface.

Big-stone
Point.

From Balsam Bay a marsh extends towards Big-stone Point and a sand-beach runs along in front of it through which there is but one narrow gap. Big Stone Point is the end of a dry, level meadow about five feet above the water, surrounded by a ridge of limestone gravel. This gravel is more or less rounded on the east side while on the west it is angular, and towards the point is often in large blocks. It is a mottled, Trenton limestone and there are but few granite or other boulders on the point. In view of this latter fact it appears probable that the limestone is shoved up by the ice from rock in place, beneath the water on the west side of the point. It is possible that it is derived from boulder-clay, but the extreme scarcity of granite boulders

and the want of granite pebbles and sand, would make this improbable. From Big Stone Point to the mouth of Brokenhead River the shore is low and sandy and this character is maintained to the mouth of Red River.

Brokenhead River.

The mouth of the river is obstructed by a sand-bar, but within it has a well-defined fairly straight channel through the marsh up to the northern side of the Indian reserve, where the land rises slightly and is dry and wooded with poplar. At the lower part of the bank the till contains numerous limestone pebbles; on the top there is, however, a thin layer of alluvial deposit. The river above becomes winding with reeds on the inner side of the bends. About one and a half miles up, within the reserve, on the west side of the river, the bank is twelve feet high, and shows nine feet of mottled Trenton limestone. A little more than a mile farther up the river, a somewhat similar exposure of limestone is seen on the east side. Just above this the river becomes shallow and obstructed by boulders and maintains this character for half a mile, when it becomes narrow and flows between boulders, with a total fall of about four feet. Here the east bank is sloping while the west bank is steep and occasionally scarped, showing it to be composed of a light-gray, unstratified till with many pebbles and some boulders, almost all of limestone. On the bank, too, are many angular masses of mottled Trenton limestone evidently out of the till, but probably not far from beds in place.

Brokenhead
River.

APPENDIX I.

LIST OF GLACIAL STRIÆ.

Glacial Striæ.	Stonewall.	S. 25° E. and S. 10° W.
	Stony Mountain.	S. 19° E.
Assiniboine River—		
	Sect. 23, T. 9 R, X	S. 38° 30' E.
Saskatchewan River—		
	Below Roche Rouge.	S. 12° 30' W.
	At Roche Rouge.	S. 12° W.
	Grand Rapids (bottom).	S. 2° 30' W.
	" " (middle).	S. 62° 30' W.
	" " (top) second set.	W. 2° 30' N.
Cedar Lake—		
	Island, east of Rabbit Point	S. 18° 30' W.
	Mouth of Saskatchewan River.	S. 39° W. and S. 65° 30' E.
	South-east shore.	S. 19° 30' W.
Lake Winnipeg—		
	Near Buffalo River.	S. 2° W. and S. 22° W.
	" " "	S. 37° 30' E. to S. 57° 30' E.
	Robinson Point.	S. 2° W.
	Head of Nelson River.	S. 54° W.
	Near Montreal Point.	S. 35° W.
	Spider Island Point.	S. 30° W.
	Spider Islands	S. 34° W.
	Mouth of Belanger River.	S. 32° W.
	North of Belanger Point	S. 23° W.
	Belanger Point	S. 20° W.
	From Belanger Point to Black River.	S. 48° W. to S. 22° W.
	Mouth of Big Black River.	S. 23° W.
	H. B. Co.'s Post Poplar River.	S. 40°-48° W.
	Poplar Point.	S. 37° W.
	Marchand Point.	S. 32° W.
	Island in Berens River Bay	S. 57° W.
	Berens River, H. B. Co.'s Post.	S. 57° W.
	Pigeon Point.	S. 56° W.
	" earlier striæ	S. 18° W.
	Pigeon Bay.	S. 17° W., S. 38° W. and S. 57° W.
	Flathead Point.	S. 53° W.
	Rabbit Point	S. 58° W.
	Opposite Dog Head	S. 54° W.
	Opposite Limestone Cave Point.	S. 48° W.
	Opposite Bull Head.	S. 53° W.
	Mouth of Loon Creek (earlier).	S. 5° W. to S. 30° W.
	" " (later).	S. 55° W. to S. 70° W.

Lake Winnipeg—*Concluded.*

Loon Island (earlier).....	S. 30° W.
" " (later).....	S. 55° W.
N. E. point Black island.....	S. 62° W.
North shore Black Island.....	S. 63° W.
South side Black Island	S. 57° W. and S. 65° W.
Mouth of Hole River.....	S. 66° W.
Hole River to Clement Point.....	S. 53° W. to S. 58° W.
Badthroat River (earlier).....	S. 27° W.
" " (Inter).....	S. 57° W.
McDermott Point.....	S. 45° W.
North of Steep Rock River.....	S. 57° W.
Island near Dog Head.....	S. 50° W.
Near Sand River.....	S. 15° W. and S. 50° W
South of Little Black River	S. 54° W.
Mouth of Winnipeg River.....	S. 57° W.
Black Bear Island	S. 49° W.
N.W. end Little Tamarack Island.....	S. 51° W.
Jack Head Island.....	S. 26° W.
Berens Island.....	S. 56° W.

Badthroat River—

Portage No. 7.....	S. 52° W.
" No. 18.....	S. 57° W.
Caribou Lake.....	S. 62° W.
Muskrat Lake—	
South side ...	S. 62° W.
East side.....	S. 60° W.
Long Lake	S. 60° W.
Hole River, east boundary of I. R.....	S. 65° W.
" first rock	S. 75° W.
Hole Lake, south shore.....	S. 68° W.
" west end..	S. 73° W.
English Lake, east end.....	S. 63° W.
Rice River, upper part.....	S. 62° W.

Little Black River—

Portage No. 3	S. 55° W.
" No. 10.....	S. 60° W.
" No. 24.....	S. 65° W.

Winnipeg River—

White-mud Falls.....	S. 55° W.
Outlet of Lac du Bonnet.....	S. 60° W.
South side, Lac du Bonnet.....	S. 62° W.
Near east end, Lac du Bonnet.....	S. 25° W.
Point in sect. 14, T. 16, R. XI.....	S. 60° W and S. 25° W.
Mouth of Whitemouth River (earlier).....	S. 27°-30° E.
" " " (later)	S. 60°-63° W.

Playgreen Lake—

Opposite Old Norway House	S. 45° W.
Goose Island.....	S. 45° W.

Little Playgreen Lake—

At Mission.....	S. 52° W.
On islands.....	S. 52° W. and S. 60° W.
Mouth of Nelson River.....	S. 36° W.

McLaughlin River—

Near first lake.....	S. 32° W.
Between first and second lakes.....	S. 20° W.
Upper lake. ...	S. 41° W.

Gunisao River—

At several places above forks.....	S. 30° W.
Near Gunisao Lake.	S. 11° W.
East end, Gunisao Lake.....	S. 16° W. and S. 11° W.
Upper Gunisao Lake.....	S. 11° W.

Belanger River—

Fourteen miles up.....	S. 21° W.
At forks	S. 27° W.
Near head of river.....	S. 17° W.

Black River—

First rapid	S. 25° W.
Pelican portage.....	S. 3° E.

Poplar River—

Ten miles up.....	S. 32° W.
White Mud portage.....	S. 20° W.
Thunder Lake.....	S. 35° W.

Etomami River—

Willow portage.....	S. 60° W.
Eight miles below Boulder Rapid	S. 57° W.

Pigeon River—

Six miles up	S. 58° W.
Three miles below Poplar Falls.....	S. 64° W.
Five miles above Poplar Falls.....	S. 64° W. and S. 34° W.
Near Jack River portage.....	S. 64° W.

Bloodvein River—

Four miles above Little Bloodvein River....	S. 58° W.
Sasa-ginnigak Lake.....	S. 57° W.

APPENDIX II.

NOTES ON EARLY TRAVELLERS ON LAKE WINNIPEG WHOSE RECORDS OR REPORTS CONTAIN DESCRIPTIONS REFERRING TO THE LAKE.

DE LA VERENDRYE, 1734-1739.

In March, 1734, the eldest son of *Sieur de la Verendrye* descended *Winnipeg River* from the *Lake of the Woods*, and probably reached *Lake Winnipeg*; and in the autumn of the same year, one of his sons descended the river and built *Fort Maurepas* on the north side at the mouth.

On the 16th of April, 1739, being at *Fort la Reine* (*Portage la Prairie*), *Verendrye* sent his son, *Pierre Gautier*, with an Indian to make an examination of the bottom of *Lake Winipigon*, of the mine which is on the lake and of that which is on *White River* (probably the *Saskatchewan*, which is called *White* or *Hinds River* on *Jeffrey's* map of 1762) of the outlet to the lake, to go round it, to endeavour to hinder the Indians from going to the English.

(*Découvertes et Etablissements des Français dans l'Ouest, &c. Journal de Laverendrye. Canadian Archives. Report 1889, p. 26.*)

JOSEPH LA FRANCE, 1740-1742.

In a book entitled "*An Account of the Countries adjoining to Hudson's Bay*, by *Arthur Dobbs*, London, 1744," there is an account of this traveller. His father was a French trader or trapper and his mother a *Sauteau*. *La France* was a native of *Michilimackinac*, and lived for a short time in *Quebec* and *Montreal*, but spent the greater part of his life—up to the age of 33 years, around lakes *Huron* and *Superior*. He had been denied a license to trade, by the French Governor, and in 1739, while on his way eastward with furs, he met a brigade of canoes in charge of French soldiers. By them he was seized and all his effects confiscated, but he managed to escape to the woods with but his gun and five charges of powder and ball. He then determined to make his way to the English on *Hudson Bay*. In the beginning of the winter he set out on his journey. In the spring of 1740 he reached the *Grand Portage* and from there he descended the *Rainy* and *Winnipeg* rivers, in September reaching '*Ouinipique*' Lake. He spent the autumn and winter hunting beaver with

the Crees on the north-eastern side of the lake. He describes the lake and the Indians who inhabit its shores. He speaks of the lake being no more than ten leagues wide and in some places not above a league and a half. The outlet is into the 'Little Ouinipique' by a river he calls the Red River, or 'little Ouinipique,' after a course northward of about sixty leagues. 'This lake is thirty-three leagues long and six broad. There is but one little island in it, almost on a water level, called by the Indians 'Mini Sabique.' The course of this lake is north-and-south through a low woody country. To this La France descended in a canoe in the summer of 1748. 'He passed this lake and the river that runs into Lake Du Siens [sic] in summer and autumn; this is about 100 leagues from the other.' Lake Du Siens is three leagues in circuit and full of wild rice. He spent the winter of 1741-42 between Lake du Siens and Lake Cariboux. This lake is ten leagues long and five broad. From here he travelled eastward fifteen leagues to Pachegoia, or Lac des Forets, from which he descended to York Factory. 'Pachegoia is divided so as to make about two lakes.'

In the work above referred to, are also descriptions on pages 20-21, of Nelson River and Lake Winnipeg. It is described as coming from another lake called the 'Junction of two Seas,' because the land almost meets in the middle of the lake. 'The west side is full of fine meadows filled with wild oxen. This lake is 400 leagues in circumference.'

"A hundred leagues west-south-west along the river is another lake they call Ounipigouchih or the Little Sea. It is 300 leagues in circumference; at the further end is a river which comes from Tacamïouen, which is not so great as the other; it is into this lake that the river of Stags is discharged, which is of such length that the natives have not yet discovered its source. From this river they can go to another which runs westward.' This is evidently from information from Jeremie. (See Dobbs, p. 54.)

ALEX. HENRY, 1775.

On the 16th of August, 1775, Alexander Henry reached Lake Winnipeg on his way from Montreal to Churchill River. At the mouth of Winnipeg River he found a village of Cree Indians, and he has given an interesting account of their customs and general appearance. Journeying along the lake he passed Pike River on the first of September, to the west of which, he states, 'is a rock of great length called Roche Rouge, and entirely composed of a pierre à calumet, or

stone used by the Indians for making tobacco pipe bowls, It is of a light red colour interspersed with veins of brown and yields very readily to the knife.' Probably the cliff at Cat Head.

(Travels and adventures in Canada, by Alexander Henry, Esq. New York, 1809. 12 mo.)

DAVID THOMPSON, 1790-1812.

In June, 1790, David Thompson, then a clerk in the service of the Hudson's Bay Company, started from Cumberland House on his way to York Factory. While on his journey he made a track-survey of the north end of Lake Winnipeg—the first systematic survey that was made on the lake. During the succeeding twenty-two years, he crossed the lake and surveyed its shores a number of times and on his map of the North-west, made in 1813-1814, its contours are first laid down with a reasonable degree of accuracy.

A. HENRY, JR., 1799-1808.

Between 1799 and 1808 Alexander Henry, Jr., was in charge of trading posts of the North-west Company in the Red River district, and crossed Lake Winnipeg several times from the mouth of Winnipeg River to that of Red River. In the latter year he travelled along the west shore to the Saskatchewan River on his way to the plains. He notes many interesting points about the early history of the country.

(The Manuscript Journals of Alex. Henry, edited by Elliott Coues, 1897.)

SIR A. MACKENZIE.

In his 'General History of the Fur Trade' in the first part of his 'Voyages' Sir Alexander Mackenzie gives a general account of Lake Winnipeg and the rivers that flow into it. In several places he makes slight references to the underlying geological structure of the country. In speaking of the Red and Assiniboine rivers he says:—'In some parts there are rapids, caused by occasional beds of limestone and gravel; but in general they have a sandy bottom. This lake in common with those of this country, is bounded on the north with banks of black and gray rock and on the south by a low, level country, occasionally interrupted with a ridge or bank of limestones, lying in stratas, and rising to the perpendicular height of from twenty to forty feet; these are covered with a small quantity of earth forming a level surface, which bears timber, but of a moderate growth and declines to a swamp.'

Limestone is also mentioned on the Saskatchewan at the Grand Rapids and above.

(*Voyages from Montreal*, by Alex. Mackenzie, London, 1801, 4to pp. lxiv and lxvi.)

DANIEL W. HARMON, 1800-1819.

D. W. Harmon in 1800 crossed Lake Winnipeg from the mouth of Winnipeg River to the mouth of the Little Saskatchewan River on his way to Swan River, and in 1805 having descended the Assiniboine he crossed from the mouth of Red River to Winnipeg River. The same year he returned west to the fort on the South Branch and in 1807 again returned to Winnipeg River on his way to Fort William. In 1808 he crossed the lake on his way to Peace River and thence to New Caledonia. In 1809 he passed east by the same route on his way to Montreal. Though his journal is interesting, as giving much useful information about the character of the country and its inhabitants at that time, he nowhere speaks about the rocks or soil around Lake Winnipeg.

(*A Journal of Voyages and Travels in the interior of North America*, by Daniel Williams Harmon. Andover 1820.)

ABEL EDWARDS, 1812.

'Notes taken during the summer of 1812, on a journey from York Fort, Hudson's Bay, to Lake Winnipeg and the Red River, by Mr. Abel Edwards, surgeon at the settlement on Red River; together with a description of the specimens collected by Mr. Edwards and by Mr. Holdsworth, surgeon at York Fort,' is the title of a paper in which the water and depth of the lake is described. 'The coast on the eastern side, until you arrive at the Straits is low and sandy, but numerous rocks lie concealed at a little distance from the land. In the Strait the coasts on both sides are bold and rocky.' Two specimens from this lake are described, one a coarse-grained granite from an island north of Bloodvein River and the other 'a grayish fine-grained rock consisting of quartz and mica with some carbonate of lime from the west side of the lake near Buffalo Island.'

(*Trans. Geol. Soc.*, 1st Series, vol. v., London, 1821, pp. 606-607.)

GABRIEL FRANCHERE, 1814.

In June, 1814, Gabriel Franchere on his way from the Columbia River, crossed Lake Winnipeg from the Saskatchewan to the Winnipeg

River. A short description is given of the general character of the lake.

(Narrative of a voyage to the North-west Coast of America, in the years 1811, 1812, 1813 and 1814 by Gabriel Franchere, English Edition 12 mo., New York, 1854, pp. 329-330.)

FRANKLIN AND RICHARDSON. 1819-1822.

Captain (afterward Sir John) Franklin and Dr. (afterward Sir John) Richardson, travelled through the northern portion of Lake Winnipeg, from October 7th to 9th, 1819. On the return journey they reached Norway House on July 4th, 1822, on their way back to York Factory. Brief notes are given in his narrative describing the north shore and the limestone of the west shore, north of the Saskatchewan River.

(Franklin's Journey to the Polar Sea, 4to, 1823.)

FRANKLIN, 1825-1827.

In February, 1825, Capt. John Franklin, with Dr. Richardson, Lieut. Back, Mr. Kendall and Mr. Drummond embarked at Liverpool for New York. Thence they passed westward to Fort William, and proceeded by the old north-west route to Cumberland House and west to Great Slave Lake. On their way east in the summer of 1827, they went from Cumberland to Norway House by the north end of the lake, and thence down the lake to Fort Alexander, from which place they proceeded to Montreal by the Ottawa River route. In passing Ottawa, Franklin laid the corner stone of the Rideau Canal Locks, in August, 1827.

In Appendix I. to Franklin's Narrative, Dr. Richardson gives an account of the limestone of Lake Winnipeg and the Saskatchewan River. He first gives its colour, structure, fracture and other general characters. He then enumerates the fossil forms found in the exposures at the first and second rocky points. On pages 54-57 he says:—'In the flat limestone strata near its foot, [Pasquia Hills] there are salt springs, from which the Indians sometimes procure a considerable quantity of salt by boiling, and there are several sulphureous springs within the formation.' * * 'The line of contact of the limestone with primitive rocks of Lake Winnipeg is covered with water; but at the Dog's Head, and near the north end of Beaver Lake, they are exposed within less than a mile of each other. To the southward of the Dog's Head, in Lake Winnipeg and a few other quarters, some schistose rocks, belonging to the transition series, are interposed between the two formations.'

A little farther on he states that the limestone of Lake Winnipeg is probably of the same age as that on Elk and Slave rivers, but that it differs in that it contains little or no petroleum.

(Narrative of a Second Expedition to the shores of the Polar Sea in 1825, 1826 and 1827, by John Franklin, Capt. &c. Appendix I. by Dr. John Richardson.)

IN the maps of Lake Winnipeg accompanying this narrative, gneiss and greywacké is marked south of the narrows on the east side of the lake, while north of this, limestone is marked on the west shore.

MAJOR LONG, 1823.

The expedition under the command of Major Long, sent out by the United States Government in 1823 to determine the position of the International boundary at the Red River, proceeded down to Lake Winnipeg, after having accomplished their mission. The return journey was made up the Winnipeg River and through the Lake of the Woods eastward to Lake Superior. Mr. W. H. Keating, the geologist to the expedition, in his narrative notes the presence of primitive rocks on the Winnipeg River. He also adds :—‘ It appears probable from all the information which we have collected, that the whole of the eastern shore of Lake Winnepeek, is occupied by a primitive formation while the western is composed of secondary, and these probably limestone, rocks. This accounts for the fact that the prairies are limited to the east by that lake, while they extend as far north as the Saskatchewan and to a considerable distance up that stream. It appears to us by no means improbable that the excavation of this lake was occasioned by the earlier decomposition of the strata at the junction of the two formations.’

(Narrative of an Expedition to the source of the St. Peters River, compiled by W. H. Keating, A.M., &c., London, 1825.)

J. J. BIGSBY.

Dr. John Bigsby in an article in the *American Journal of Science*, vol. VIII, 1824, pp. 60-88 mentions the limestones of Lake Winnipeg and Cedar Lake as probably of the age of the mountain limestone of the Carboniferous of Europe. He also mentions finding several fossils in the loose rocks of the Lake of the Woods.

CAPT. BACK, 1833-1835.

On the 17th of February, 1833, Captain Back accompanied by Mr. Richard King, sailed from Liverpool for New York, whence he pro-

ceeded to Montreal. Here he embarked in canoes, ascended the Ottawa, crossed lakes Huron and Superior and arrived at Fort William May 20th. From here he proceeded to Fort Alexander at the mouth of Winnipeg River, where he arrived on June 6th. He then traversed Lake Winnipeg to Norway House, from which place he crossed to the Saskatchewan and Cumberland House, and proceeded via Isle à la Crosse to Great Slave Lake. In the summer of 1835 he retraced his way through Lake Winnipeg and back to Montreal. On page 52 of his narrative, Back mentions that the east side of Lake Winnipeg is composed of smoothed and rounded granitic rocks of little altitude.

He speaks of ridges of sand and of the water rising in the lake. On page 60 he speaks of laminated clays at the north end of the lake, west of which are limestone rocks. In appendix IV., W. H. Fitton, naturalist to the expedition, quotes a letter from Mr. Stokes, concerning the *Orthocerata* found by Dr. Richardson and Capt. Back on Lake Winnipeg, comparing them with those described by Bigsby from Lake Huron. 'There is also one specimen which though not in good preservation, is doubtless a *Catenipora* or chain coral, a genus characteristic of the older transition limestones, in which beds also, *Orthocerata* are common.'

(Narrative of the Arctic Land Expedition &c., in the years 1833, 1834 and 1835 by Capt. Back, R. N. 8vo. London, 1836.)

SIR JOHN RICHARDSON, 1848.

On the 10th of April, 1848, Sir John Richardson and Mr. John Rae landed at New York, and proceeded to Montreal by Lake Champlain and thence by steamer through the lakes to Sault Ste. Marie, which they reached on April 29th. Here they took canoes for the remainder of the journey, passing through Lake Winnipeg the first week in June on their way to the Mackenzie River. In August, 1848, he again traversed Lake Winnipeg, calling at Norway House, and then travelling along the east shore of the lake. On pages 62-70 of his account he says :—'When we descended to Lake Winnipeg we came upon epidotic slates, conglomerates, sandstones and trap rocks, similar to those which occur on the northern acclivity of the Lake Superior basin; and after passing the straits of Lake Winnipeg, we have the granite rocks on the east shore, and Silurian rocks (chiefly birds-eye limestone) on the west and north, the basin of the lake being mostly excavated in the limestone. The two formations approach nearest to each other at the straits in question, where the limestone, sandstone, epidotic slates, green quartz rock, greenstone, gneiss and granite, occur in the close neighbourhood of each other.'

He then goes on to give the general character of the coast line and the mode of formation of bars and marshes around the shore. 'Considerable sheets of water are also cut off on the north-west side of the lake, where the birds-eye limestone forms the whole of the coast.'

He also mentions the influence the ice has in shoving up boulders on the shore. In Appendix No. 1, he also refers to the physical features of the Winnipeg valley.

(Arctic Searching Expedition, &c. by Sir John Richardson, London, 1851, New York, 1854.)

D. D. OWEN, 1848.

In the summer of 1848, David Dale Owen, while making a geological survey of Wisconsin, Iowa and Minnesota, for the United States government, descended the Red River to Lake Winnipeg and ascended the Winnipeg River to Lake of the Woods and thence to Lake Superior. He describes the character of the country around Upper Fort Garry (or Winnipeg) and the rock exposures at Lower Fort Garry, giving a list of fossils and analyses of two specimens of the rock. The beds are stated to be of the same age as the Upper Magesian limestone of Wisconsin. He also describes the exposures on Lake Winnipeg, east of Red River at Poplar Point, and in a small bay near Big Swamp Point.

(Report of a Geological Survey of Wisconsin, Iowa and Minnesota, by David Dale Owen, United States Geologist, Philadelphia, 1852.)

RED RIVER EXPLORING EXPEDITION, 1857-58.

The expedition to explore the country between Lake Superior and Red River was placed under the command of Geo. Gladman with S. J. Dawson, surveyor; and Prof. H. Y. Hind, geologist. The parties started out during July, 1857, and pushed through to Fort Garry. The first report for 1858 contains letters descriptive of the country between Lake Superior and Red River, and in it Prof. Hind outlines a report on the country.

In the spring of 1858 the expedition was divided under the direction of S. J. Dawson and Prof. Hind, and the final reports form Appendix No. 4 to the Seventeenth volume of the Journals of the Legislative Assembly of the province of Canada, Session 1859. The report by S. J. Dawson contains a short description of the country and large maps and profiles. That by Prof. Hind deals more fully with the geology of the Lake Winnipeg basin than any previous one, and some of his notes and descriptions are quoted in the body of the present report.

S. H. SCUDDER, 1860.

In 1860, Mr. S. H. Scudder made a canoe trip from Fort Garry to The Pas on the Saskatchewan River. He described the *Orthoptera* collected by him, in the Canadian Naturalist, vol. VII., 1862 (pp. 283-288). He does not there make any notes on the geology. Subsequently he published an account dealing more especially with the incidents of the journey, and in this are a few references to the character of the coast on the west side to the mouth of the Saskatchewan River.

(The Winnipeg Country, or roughing it with an eclipse party, by a Rochester fellow. Boston : Cupples Upham & Company. 1886. 8 vo.)

A. R. C. SELWYN, 1872-73.

In the summer of 1872, Dr. A. R. C. Selwyn descended the Winnipeg River and coasted the south east shore of Lake Winnipeg to the mouth of Red River. The following summer he traversed the lake from the mouth of Saskatchewan River to the Red River. His reports refer to the superficial deposits of the south-east shore, and he also notes the presence of the limestone on the west side.

(Reports of Progress, Geol. Surv. Can., 1872-73 and 1873-74.)

R. BELL, 1874 and 1878.

In 1874 Dr. R. Bell descended the Little Saskatchewan River from Lake Manitoba and followed the shore to the mouth of Red River. He gives a short account of the limestone cliffs as far as Dog Head.

Returning from Hudson Bay in 1878 he gives a short account of the character of the Laurentian rocks of the east shore with lists of strikes of the gneisses and direction of the glacial striæ. An uncoloured map of Lake Winnipeg is published with this report.

(Reports of Progress, Geol. Surv. Can., 1874-75 and 1877-78.)

A. S. COCHRANE, 1882.

In 1882 Mr. A. S. Cochrane made track-surveys of Berens River to above Family Lake, Pigeon River for fifteen miles of its course, Big Black River for eighty-two miles from its mouth and Poplar River from a portage from Big Black River to its mouth. He also made a sketch survey from Norway House to Grand Rapids.

(Report of Progress, Geol. Surv. Can., 1880-82 Summary, pp. 16-17.)

T. C. WESTON, 1884. -

A large collection of fossils was made by Mr. Weston from the rocks of the west shore from Cat Head south to the Red River.

(Annual Report, Geol. Surv. Can., vol. I, (N. S.), 1885, p. 26A.)

A. P. LOW, 1886.

In 1886, Mr. A. P. Low crossed Lake Winnipeg from Red River to Berens River and ascended the latter to a portage to the head-waters of the Severn River. His observations are confined to the valley of the Berens River and to that of the Severn.

(Annual Report, Geol. Surv. Can., vol. II, (N. S.), 1886, part F.)

F. W. WILKINS, 1886.

In the summer of 1886, F. W. Wilkins under instructions from the Dominion Lands Branch of the Department of the Interior made a micrometer survey of the shore of Lake Winnipeg. In his account of this work he gives a running description of the lake and the adjoining country.

(Department of the Interior, Report for 1886, part II.)